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Commonwealth of Massachusetts
Executive Office of Environmental Affairs

Department of Environmental Protection

William F. Weld
Governor
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Commissioner

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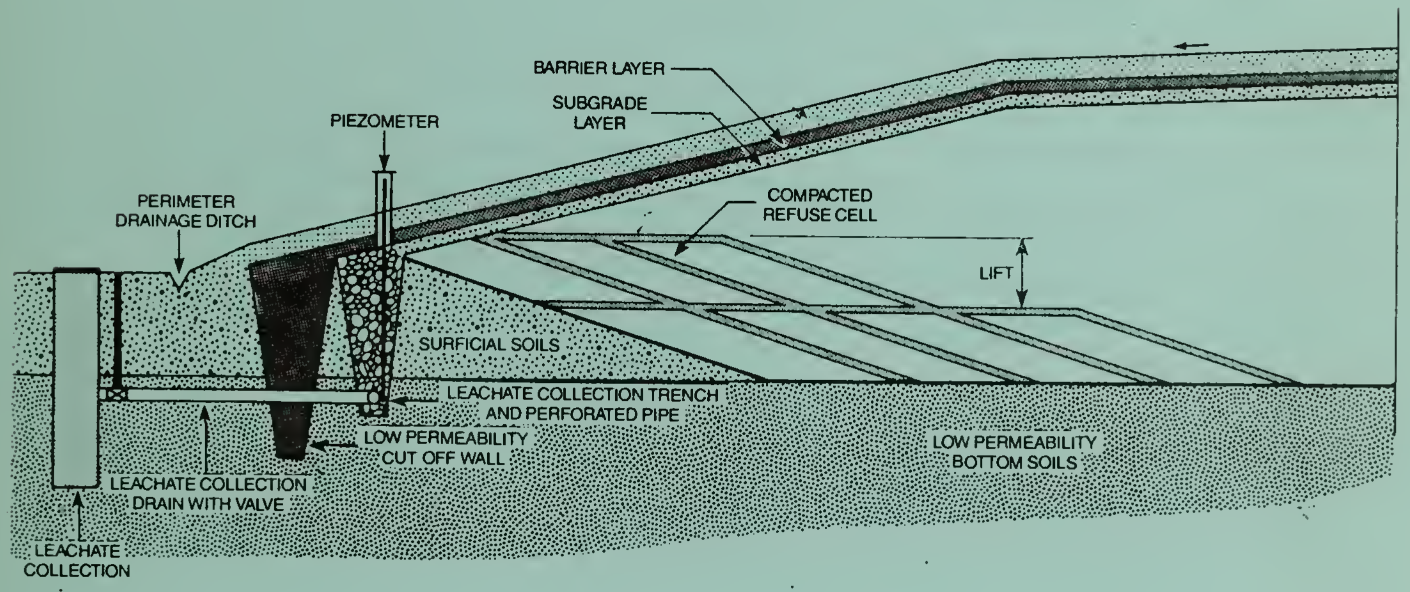
LANDFILL ASSESSMENT AND CLOSURE GUIDANCE MANUAL


BARRIER LAYER
SUBGRADE LAYER
PIEZOMETER
PERIMETER DRAINAGE DITCH
COMPACTED REFUSE CELL
LIFT
SURFICIAL SOILS
LEACHATE COLLECTION TRENCH AND PERFORATED PIPE
LOW PERMEABILITY CUT OFF WALL
LOW PERMEABILITY BOTTOM SOILS
LEACHATE COLLECTION DRAIN WITH VALVE
LEACHATE COLLECTION

REVISED
MAY, 1992

EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF SOLID WASTE MANAGEMENT

ENVIRONMENTAL PROTECTION AGENCY
SOLID WASTE AND GEOGRAPHIC INFORMATION SECTION

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Commonwealth of Massachusetts
Executive Office of Environmental Affairs
Department of Environmental Protection

William F. Weld
Governor
Daniel S. Greenbaum
Commissioner

May 7, 1992

Dear Municipal Official:

The Department of Environmental Protection is pleased to present our second round of Landfill Assessment and Closure Seminars and this accompanying Guidance Manual. The seminars and guidance manual are the result of a continuing effort by the Department's Division of Solid Waste Management to assist municipal landfill owners and operators in preparing to assess and close their landfills.

The information contained in this guidance manual and presented in the seminars enable you to gain a better understanding of new assessment and closure technologies. It prepares municipal leaders to gain the support of their constituency in undertaking landfill assessment and closure and to work with consultants to design a program which adequately protects the public health, safety and the environment.

I call your attention to a number of sections of the guidance manual which have been revised this year. The Chapter on solid waste fees and financing procedures has been expanded reflecting the continuing fiscal difficulties with which communities are faced. The landfill gas and stormwater management chapters of the manual's technical section have also been expanded. The manual contains a new appendix detailing procedures for obtaining computer generated maps for planning and assessment activities.

DEP's Landfill Assessment and Cleanup Program continues to receive assistance from the United States Environmental Protection Agency, Solid Waste and Geographic Information Section, enabling the Department of Environmental Protection to offer these seminars and manual at no cost to Massachusetts communities. Thank you for attending these seminars. Please feel welcome to call on the Department's Solid Waste Management staff for continued assistance in the landfill closure process.

Sincerely,

Daniel S. Greenbaum

One Winter Street • Boston, Massachusetts 02108 • FAX (617) 556-1049 • Telephone (617) 292-5500

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION I
J.F. KENNEDY FEDERAL BUILDING, BOSTON, MASSACHUSETTS 02203-2211

Dear Municipal Official:

Last year, the United States Environmental Protection Agency (EPA) funded a cooperative agreement with the Massachusetts Department of Environmental Protection (MADEP) to develop a training and technical assistance program for municipalities implementing Municipal Solid Waste (MSW) landfill assessments and closures. Our goals in this endeavor are two-fold.

First, a major goal of EPA in the MSW program is the transfer of technology to State environmental agencies and to municipalities faced with solid waste disposal problems. The training and technical assistance program developed by MADEP under this grant is an effective means of providing information on new technologies and management methods to municipal officials. The timeliness of this information is critical as Massachusetts cities and towns prepare to meet compliance schedules for assessment and closure under the 1990 Massachusetts solid waste regulations.

A second goal of the grant is to establish a pilot project for training relative to Resource Conservation and Recovery Act (RCRA) Subtitle D landfill regulations which will impact landfill operation and closure. EPA will shortly promulgate these new Federal regulations, the so-called "Criteria" for MSW landfills.

As part of this pilot project, EPA and the states will evaluate the results of the training and will modify the program accordingly prior to initiating proposed technical assistance within the six New England states.

The technical assistance portion of the cooperative agreement is an integral part of the seminar series. Under the grant EPA has provided a staff person to the MADEP to assist municipalities in landfill assessment and closure implementation. I hope you will take advantage of this opportunity for assistance.

The EPA is pleased with the enclosed training manual and the proposed seminar schedule. I hope that you will find the seminars and follow-up technical assistance beneficial. We thank you for taking the time and interest in the seminar series.

Sincerely,

Julie Belaga

Julie Belaga
Regional Administrator

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COURSE OBJECTIVES

1. Transferring Information on New Technologies

Solid waste regulatory activities have seen great advancement over the past five years. Chapter 584, the Solid Waste Act of 1987 brought landfill assessment, integrated solid waste management and recycling programs to the Commonwealth. The promulgation of 310 C.M.R. 19.00 the Massachusetts Solid Waste Management Regulations codified a new level of technology to be applied to landfills in an effort to provide better protection to public health, safety and the environment. These regulations were developed with knowledge that the Environmental Protection Agency, our Federal counterpart, adopted parallel regulations Sub-Title D in October of 1991.

The purpose of this training manual is to provide detailed information on the new technologies that municipalities will be expected to implement in order to properly close their sanitary landfill.

2. Understanding Landfill Costs and Developing Fees Systems and Enterprise Funds to Meet These Costs

Along with the addition of new technical requirements the availability of State and Federal grant monies have become non-existent. Some veterans of the Water Pollution Grants programs believe that this is not all bad. Grant programs can lead to over designed and over built projects.

Massachusetts municipalities can expect to fall in line with many of the States throughout the country that rely on fee programs to raise the necessary revenue for capital and operational costs of solid waste operations. In conjunction with new fee programs, municipalities will need to adopt enterprise accounts to assure that the money that is collected from solid waste fees are not re-assigned for non-solid waste expenses.

The second section of the manual provides information on landfill costs, fee development and enterprise funds to assist municipalities in raising the funds necessary for landfill assessment and closure activities.

3. Developing Planning and Implementing Strategies for the Landfill Assessment Process

Section Two of the manual also addresses consultant contracting, planning and management activities necessary to implement landfill assessment and closure technologies. This section also discusses requirements under Chapter 30B for contracting of services by municipalities.

PART I. TECHNICAL GUIDANCE

The technical guidance section is intended for use by municipal officials, consultants, landfill operators and others involved in the planning and design, construction, operation, maintenance and monitoring of landfills. This document is intended to fulfill three major functions: 1) to serve as a standard reference document for landfill design, construction and QA/QC activities; 2) provide additional guidance on acceptable standards and methods for landfill design, construction and Quality Assurance/Quality Control procedures to ensure that a landfill will meet the performance and design standards established in Part II, Landfill Design and Operational Standards of the Solid Waste Management Facility Regulations, 310 CMR 19.000; and 3) provide for state-wide consistency in the permitting of landfills.

The Landfill Technical Guidance Document is organized to provide guidance on specific topics of interest to those designing and constructing landfills or expansions thereof, including: design and construction of liners and final covers; quality assurance/quality control of liner and final cover construction; environmental monitoring systems; surface water control; and closure and post-closure guidance.

This is the first revision to much of the technical guidance section. Many areas, as they relate to sanitary landfills, are steadily evolving. As such, some of the chapters will undergo further development as more information is obtained by the Department.

CHAPTER 1 GROUND WATER PROTECTION AND FINAL COVER SYSTEMS DESIGN AND CONSTRUCTION

I. INTRODUCTION

The solid waste management facility regulations require that a ground water protection system (commonly referred to as a liner system) be installed at all new or expanding landfills.

The purpose of a liner system is to prevent leachate from reaching groundwater by collecting leachate for treatment and disposal. By preventing the movement of leachate into ground water the liner serves to protect ground water and surface water from pollution.

Liner systems should have the following characteristics:

- be designed as fully closed systems for the collection of leachate generated within the landfill;
- provide an effective hydraulic barrier during the active life, closure and post-closure periods to impede the infiltration of leachate into ground water;
- have little or no chemical reaction with waste, thereby preventing an increase in the liner's permeability;
- maintain its integrity and performance under all operating conditions for the expected life and post-closure period of the facility.

II. EQUIVALENT LINER DESIGN

In order to allow flexibility in the design of facilities and to allow for use of new materials in the future, the regulations (19.105) allow an owner or operator to propose ground water protection system designs or final cover system designs which differ from the minimum design specified in the regulations. The proponent must demonstrate that the alternative design will provide an "equivalent" level of protection to surface water and ground water resources when compared to the standard liner design and have the characteristics outlined above.

An alternative liner design will be approved only when the applicant is able to demonstrate, to the satisfaction of the Department, that the alternative design will:

- achieve the performance standards specified in the regulations;
- protect surface and groundwater resources;
- be equivalent or superior to the minimum design standards established in the regulations.
- utilize materials, technologies or methods that have been demonstrated to have been successful in similar applications;
- be constructed using acceptable Quality Assurance/Quality Control procedures.

Where a proposed alternative design incorporates materials and/or technologies that have not previously been demonstrated to meet performance standards the Department may choose to approve of the alternative design as a demonstration project limited only to a portion of the site.

III. GROUND WATER PROTECTION SYSTEM AND FINAL COVER WAIVERS

The Department will consider granting a waiver from a specific design requirement of the ground water protection system or final cover system components for certain types of landfills where it can be demonstrated to the Department's satisfaction that the minimum design is unnecessary to adequately protect ground water or surface waters. Generally, a waiver will not be granted to entirely eliminate a design component, but rather to waive or modify the technical requirement of that component. Pursuant to 310 CMR 19.114 landfills handling municipal solid wastes or solid waste combustion facility ash may not apply for a waiver under this section. However, stump and brush landfills and inert waste landfills may be considered for waivers. Factors to be considered by the Department in reviewing waiver requests will include:

- the type of solid waste to be disposed;
- the quality and quantity of leachate likely to be generated;
- the physical or hydrogeological characteristics of the site.

In addition to the above situations, 310 CMR 19.113 allows alternative final cover systems which may be sought for all types of landfills where a landfill assessment has determined that one or more components of the final cover are not required to protect public health, safety or the environment. In general, a request for a waiver of this type would be applicable to old landfills which have not been active for a period of time.

IV. MINIMUM GROUND WATER PROTECTION SYSTEM DESIGN

The minimum ground water protection system design required by the Solid Waste Management Regulations for landfills (19.110) must include:

- a sub-grade layer which will ensure maintenance of a four foot separation between the top of bedrock or the maximum high groundwater level and the bottom of the lowermost low permeability layer;
- a composite liner consisting of a two foot thick recompacted soil liner with a maximum in-place saturated hydraulic conductivity of 1×10^{-7} cm/sec overlain by a flexible membrane liner (FML) or geomembrane;
- a drainage/protection layer consisting of either soil alone or in combination with a synthetic drainage material or geonet. The layer must be a minimum of 18 inches thick, the lowermost 12 inches of which must have a minimum hydraulic conductivity of 1×10^{-2} cm/sec and the uppermost 6 inches of which must have a minimum hydraulic conductivity of 1×10^{-3} cm/sec;
- a leachate collection system which has appropriately spaced pipes. Trunk lines must have a minimum slope of 1% and lateral lines a minimum slope of one-half percent (½%); and
- a leachate pumping facility, or a leachate storage facility if the landfill is not to be tied directly into a sewer system.

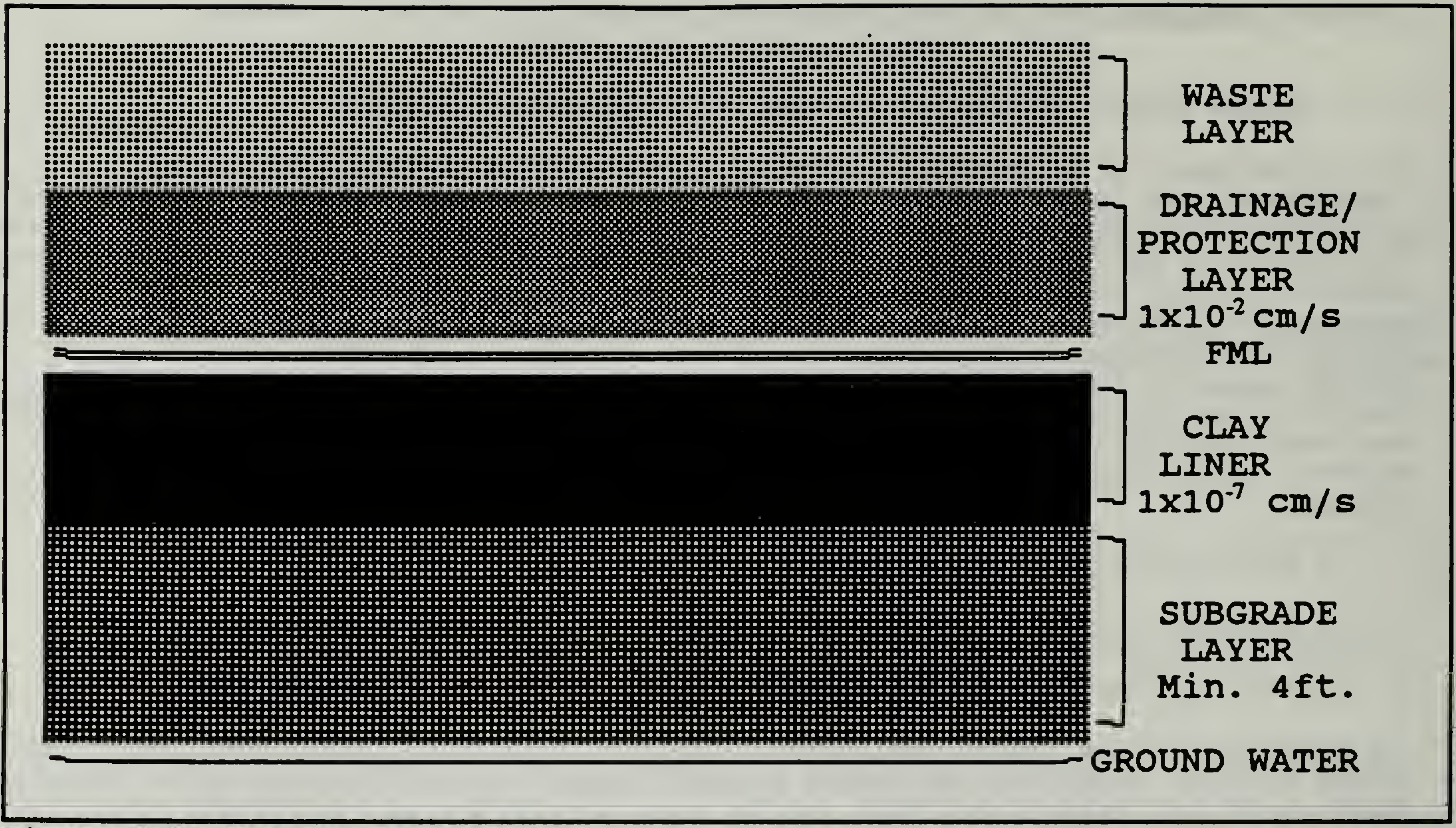

Figure 1-1: Minimum Liner Design

V. GENERAL LINER DESIGN CRITERIA

A. Purpose

In order for liners to effectively act as a barrier to the movement of leachate into ground water and promote leachate collection the liner must be properly designed and constructed. Liners must be capable of withstanding degradation by leachate or other mechanisms and must promote the drainage of leachate off the liner as efficiently as possible. However, the leachate containment strategy must also extend beyond the selection of the liner type and materials. The overall design of the system must be carefully examined to identify potential weak points in the design and to minimize or correct failure-prone elements of the design. Potential failure points include:

- penetrations of the liner;
- negligent installation practices or poor operating procedures resulting in perforations of the liner;
- stability of the sub-base;
- areas of high stress; and
- inadequate Quality Assurance/Quality Control program.

B. Design Considerations

Liner materials must have chemical properties which will prevent failure upon exposure to solid waste leachate. Liner materials should be tested for compatibility with leachate. The following test methods should be used to evaluate the compatibility of liner materials with leachate:

- Soil Liners - EPA test method 9100 (EPA Document SW-846)
- Flexible Membrane Liners (FMLs) - EPA test method 9090 (EPA Document SW-846)

Liners must be designed to withstand pressure gradients, including static head and external hydrological forces, variations in climatic conditions and the stresses of installation and daily operation.

VI. SUBGRADE DESIGN

A. Purpose

The soil underlying a landfill must provide a proper foundation for the landfill. It must be strong enough to support both the expected load of solid waste as well as operational vehicular traffic. To prevent the possibility of a failure due to subsidence or slumping the foundation of the landfill must be designed to:

- provide proper structural support for the liner and solid waste;
- control differential settlement of the liner;
- control seepage and prevent piping or pathways for leachate that has migrated through the liner; and
- act as an attenuation layer for leachate.

B. Design and Construction Considerations

It is recommended that preparation of the site for the liner include the excavation and recompaction (95% of standard proctor) of the top 1 to 2 feet of foundation soil in order to control settlement of the soil and determine the suitability of the subgrade materials. In addition, any cracks, sand lenses or sand seams in the foundation must be repaired prior to placement of the liner because such incongruities may serve as pathways for leachate migration and could cause piping failures in a soil liner. Further requirements for preparation of the sub-grade layer include:

- a minimum four foot separation between the maximum high ground water and the lowermost point of the impermeable layer located above the subgrade layer;
- diversion of all surface drainage away from the landfill;
- removal of all stones with sharp edges and/or points which might penetrate the overlying impermeable layers and all stones greater than 3 inches in diameter;
- removal of all construction debris, solid wastes, organic debris and vegetation;
- a reasonably smooth surface. If not smooth the surface should be proof rolled with a smooth steel drum roller;
- have a minimum bearing capacity of 4,500 lb/ft^2 plus the total applied load.

VII. SOIL LINERS AND ADMIXTURES

A. Purpose

The low permeability soil layer acts to minimize the movement of leachate into the subgrade and ground water as well as function as an attenuation layer whereby contaminants present in leachate are adsorbed. In order for a soil barrier layer to function as designed careful consideration must be given to the method of compaction and maintenance of its proper physical parameters. The soil liner must have a uniform thickness across the entire liner and be uniformly compacted across the entire liner. Lack of uniform soil compaction is a major contributor to high seepage rates through soil liners. A quality assurance/quality control program (QA/QC) must be developed for the installation of the liner. QA/QC is addressed later in this guidance document.

B. Design Considerations

Soils used for liners should have the properties specified in Table 1-1 to meet the design standards specified in the regulations.

Table 1-1: Properties for Soils Used for Soil Liners

- minimum of 50% of the soil by weight, should pass a #200 sieve
- minimum of 25% of the soil by weight should consist of <2um clay size particles
- plasticity index should be 15% or greater, but less than 30-40%
- density should be, at minimum, 95% standard, or 90% Modified Proctor density
- maximum clod size should not exceed 1/2 of the lift thickness
- maximum rock size should not exceed 3/4 - 1 inch
- coarse fragments < 10% (or passing a #4 sieve)

C. Admixtures

An admixture is a combination of native soils and a bentonite type clay material which when added to the native soil results in a low permeability material.

Construction of liner systems or portions of liner systems using admixtures should conform to the following:

- bentonite added to native soils should be powdered to achieve the best mixing possible.
- a pugmill should be used to mix the soil and bentonite or the bentonite can be disked directly into the soil.

- a liner constructed of an admixture of bentonite and native soils should have a minimum thickness of 24 inches.

D. Soil Liner Construction Considerations

The following variables affect the ability to properly compact soil liner materials so that they meet design and performance standards:

- molding water content
- type of compaction equipment
- compactive effort applied to the soil
- size of clods
- bonding between lifts

Use of the following guidance will ensure that soil liners are compacted to the maximum possible extent and the in-place hydraulic conductivity, which must not exceed $1x10^{-7}$ cm/sec or less for each lift of a liner or cap, will be as low as possible:

- To minimize the hydraulic conductivity soils should be installed at 1-3% wet of optimum as determined by ASTM D1557. If soils are wet of optimum, corresponding permeability testing at these moisture contents must have been done prior to construction. Dry soils should be adequately wetted prior to compaction. Wet soils should be spread and allowed to dry to optimum moisture content prior to compaction.

- Liner should be installed in loose lifts which are a maximum of 9 inches thick; compacted lifts should be a maximum of six inches thick.

- Two foot thick impervious soil liners should be constructed in four six-inch compacted lifts. Eighteen inch thick caps should be constructed in three six-inch compacted lifts.

- Test pad liners should be built and tested in-situ with an infiltrometer to ensure that the soil and the compaction equipment and procedures will result in a liner that meets the standards established in the regulations.

- Clod size should be minimized to the extent possible to prevent preferential flow pathways for leachate. Clay soils should be pulverized to minimize the size of clods to the greatest possible extent.

- Bevel cuts are recommended for tieing together soil liner sections.

- Soils should be protected against desiccation both prior to and after compaction. If large areas of a liner are to be exposed long enough for significant drying to occur then a protective cover should be placed over the liner.

- Sheepsfoot rollers or other comparable compaction equipment are preferred for compaction of liners. The length of a foot of the roller should exceed the depth of one lift of the liner to achieve maximum compaction and promote the adherence of one lift to the underlying lift. It is recommended that compactors be as heavy as possible. Compactors in excess of 30,000 kg. are recommended.

- Generally, a sheepsfoot roller should make a minimum of eight passes during compaction of a section of liner.
- Where a sheepsfoot roller is not used, each lift should be scarified prior to the installation of the succeeding lift to maximize the bonding between lifts to prevent horizontal seepage between lifts.

Table 1-2: Compaction Requirements

Area	ASTM Density Degree of Compaction
Trench Backfill	92%
Landfill Cap and Cover	Minimum 90% standard proctor or 95% modified proctor or as required to meet permeability specification
General Fill	90%

VIII. FLEXIBLE MEMBRANE LINERS (FMLs)

A. Purpose

Flexible membrane liner materials or FMLs provide an additional barrier layer in the liner design. While FMLs provide an excellent barrier to the seepage of leachate from the landfill, the effectiveness of the FML in preventing leachate migration depends upon how well the FML has been installed.

B. Design Considerations

FML materials are subject to degradation through a variety of mechanisms as specified in Table 1-3. Care in selection and installation of an FML will minimize degradation problems.

The following minimum design standards apply to liner systems constructed of synthetic liner materials or geomembranes.

- Construction survivability - Selected FML must have physical characteristics that are sufficient to prevent serious degradation during the expected method of installation.
- Minimum thickness - 60 mils for HDPE materials, or a thickness providing equivalent protection if another synthetic liner material is used, but in no case less than 30 mils.
- In addition to the minimum standards established above, the following physical properties before and after exposure to landfill leachate should be documented:

Table 1-3: Methods of FML Degradation

Mechanism	Method to Minimize Degradation
Ultraviolet Light	Cover with soil and maintain
Chemical Degradation	Ensure FML is resistant - require EPA 9090 evaluation for leachate
Swelling Degradation	PVC (highest) to HDPE (lowest) swelling. Process largely reversible. May not lead to degradation, but may cause secondary effects.
Extraction Degradation	Leaching of plasticizers. Ensure FML is resistant - require tests: water extraction - ASTM D3083 volatile loss - ASTM D1203
Delamination Degradation	Only scrim or reinforced or laminated liners. ply adhesion test - ASTM D413
Oxidation Degradation	Anti-oxidants must be added to scavenge the free radicals
Biological Degradation	No documented case histories

  - burst strength;
  - dimensional stability;
  - hardness;
  - elasticity;
  - ply adhesion (for fabric reinforced materials);
  - puncture resistance;
  - seam strength of factory and field-produced seams;
  - tear resistance;
  - thickness;
  - water vapor transmission;
  - tensile strength.

- Adequate documentation of soil compatibility with the liner material should be presented, (ASTM D 3083, 1981).

- The liner material must be capable of withstanding the following stresses:

  - ultraviolet radiation
  - the load of placement on steep slopes of large landfills
  - thermal degradation of the liner material, due to extreme climatic conditions;
  - biological attack due to contact with soils and leachate.

- Seams should be capable of providing the same tensile strength as the parent material.

C. Construction Considerations

- Delivered FML materials should be closely inspected upon delivery for defects such as pinholes, cuts, cracks and defective factory seams. All defective materials should be rejected. FML materials which have been stored on-site should also be carefully inspected before being installed.

- The foundation surface should be free of all rocks, roots, desiccation cracks or water and smooth rolled. The foundation surface must be free of any materials which might abrade the FML.

- FML materials should never be dragged across their prepared foundation or subgrade, but should instead be unfolded or unrolled into place.

- The FML should be installed in direct contact with the underlying low permeability soil layer.

- FMLs installed on side slopes should be firmly anchored in anchor trenches.

- The FML must be clean and free of dust, dirt or other debris which would affect proper seaming of panels.

- FML materials should not be installed on windy days or during inclement weather that may result in poor seaming conditions. It is recommended that seaming operations take place only when the temperature exceeds 50° F.

- FMLs must be installed and seamed by qualified seamers. Installation must be overseen by a person with extensive experience in installation of FMLs.

- Field seams should run up and down side slopes and not horizontally across side slopes.

- Standpipes should be designed so as not to puncture the liner. Any necessary penetrations of the liner, if necessary, should be constructed with flexible connections.

- The FML should be covered with the drainage layer as soon as possible to prevent unnecessary exposure to ultraviolet radiation. Equipment placing the drainage blanket should always work across the lined area in such a way that it is supported by the drainage layer and is not directly on the liner.

- Trucks, large equipment, and tracked vehicles should not be allowed to drive directly on the FML or drainage blanket until at least one lift of refuse has been placed in the landfill.

IX. LINER SIDESLOPE DESIGN

A. Purpose

The sidewalls of a landfill should be designed to remain stable. Slope stability analyses should be done on the soils to ensure that slumping will not occur once waste is placed in the landfill and compacted. The following guidelines should be used when designing sidewalls:

B. Design and Construction Considerations

- The bearing strength of the foundation material should be determined to prevent foundation or liner failure. An adequate margin of safety (a minimum of 1.25) should be built into the sidewall design.
- Where FMLs are installed on side slopes, results of an analysis documenting the stability of all components of the proposed design, particularly the interface of different components, should be submitted to the Department. A safety factor of 1.25 should be incorporated into the design.
- Sidewalls should not have a slope exceeding 3 horizontal to 1 vertical.
- Freeze/thaw and dry/soak conditions should be considered when selecting liner design and liner materials, especially with regard to the depth of the drainage/protection layer. Covering the entire lined area of a landfill with one layer of solid waste may be one way to protect the liner from freeze/thaw conditions.
- Where HDPE is used, textured HDPE may be appropriate to increase the stability by increasing the interface angle of friction.
- If geonet is used it is recommended that geotextile be placed below and above the geonet to prevent liner materials from entering the geonet and to prevent the plugging of the geonet by the protective blanket. The use of non-woven geotextiles are recommended.

X. LINER BOTTOM DESIGN

A. Purpose

The bottom of a liner must be designed to promote leachate drainage and collection and to minimize the seepage of leachate through the liner into the underlying soils and ground water.

B. Design Considerations

The following guidelines should be used when designing the bottom of the liner:

- The bottom should be sufficiently sloped to prevent puddling and ponding during construction and operation. The slope shall not be less than 2%.
- Extra liner thickness and compactive effort is recommended for the toes of sideslopes and underneath all the main leachate collection system main header piping to protect against seepage.
- Penetrations of the liner should be minimized and should be properly sealed with bentonite or other sealing methods. Any penetrations should be flexible to allow for settling.
- Geotextile materials should be placed above and below geonets to prevent piping of the liner materials into the geonet and to prevent plugging of the geonet by the protective blanket.

XI. DRAINAGE/PROTECTION LAYER - Natural Materials

A. Purpose

A drainage/protection layer serves as a high permeability pathway through which leachate can travel to collection pipes and as a protective layer over the liner system to prevent damage to the liner from vehicles and solid wastes. Drainage/protection layers generally consist of natural materials, but synthetic drainage materials can be used in combination with natural materials to enhance the effectiveness of the layer in draining leachate from the landfill.

B. Design Considerations

Drainage/protection layers consisting of natural materials should have the following characteristics in order to perform properly:

- The material must be compatible with leachate. Limestone based materials will react with MSW leachate to form a precipitate which can clog the collection zone. Therefore, materials having a calcium carbonate content in excess of 10-15% should be avoided.
- For sandy soils, the soil must consist of clean sand, classified as SP by the Unified Soil Classification System (USCS), with no more than 5% passing a #100 sieve.
- The layer must be at least 18 inches thick. The lower 12 inches must have a minimum hydraulic conductivity of 1×10^{-2} cm/sec. The upper 6 inches must have a minimum hydraulic conductivity of 1×10^{-3} cm/sec.
- Granular material must be no courser than 3/8" and should be smooth and rounded to prevent abrasion to the FML.

XII. DRAINAGE PROTECTION BLANKET - Synthetic Materials

A. Design Considerations

The following guidance and recommendations apply to drainage/protection blankets which consist of synthetic materials such as geonets.

- Documentation should be provided which demonstrates compatibility of geonet or geotextiles with leachate. The following parameters should be included, and can be obtained from the manufacturer of the materials:
    - resistance to puncture;
    - thickness;
    - permittivity;
    - transmissivity;
    - mass\unit area;
    - burst strength;
    - abrasive resistance;
    - percent open area;
    - ultraviolet resistivity;
    - grab tensile/elongation;
    - equivalent opening size;
    - hydrostatic bursting strength;
    - tearing strength (trapezoidal);
    - compression behavior/crush strength;

- It is recommended that geonets provide a minimum hydraulic transmissivity of 1.5 times that of the expected overburden.
- Geonets should have transmissivity values equivalent to the granular material they replace.
- Geonets should have a minimum transmissivity of $3x10^{-5}$ m/s
- Double drainage nets can increase the total flow area.
- Geosynthetic cushion layers (non-woven geotextile) can be used where large, granular materials are used for the drainage/protection layer material to protect the FML from abrasion.

B. Geotextile Design

Geotextiles, including woven and non-woven materials may be used at the interface between the various components of the liner or final cover system to maintain the integrity of each layer. Filter fabrics are one type of non-woven geotextile. The primary function of geotextiles is to prevent the migration of soil fines into drainage layers or into leachate collection systems. Another application of geotextiles is to act as a cushion or protective layer to prevent the intrusion of FML into geonets. Important elements to include in geotextile design, depending upon application, include:

- Compatibility with leachate and other design material.
- Adequate vertical flow or permeability - usually evaluated as permittivity - ASTM D4491.
- Soil retention - Apparent opening size - ASTM D4751.
- Clogging evaluation - Gradient ratio, CW-02215, or long-term flow - GRI-GT1.
- Ability to prevent piping.
- Durability after exposure to chemical or biological degradation.
- Geotextiles in the horizontal flow path of leachate can clog with anaerobic slimes. Sized sand and stone are preferable.

XIII. LEACHATE COLLECTION SYSTEMS

Leachate collection systems must be evaluated and provided at all landfills.

A. General Design Considerations

- All proposals for new or expanded landfills must provide for active leachate control systems (i.e., leachate collection systems placed on a liner system, and the associated leachate collection tanks, treatment, discharge, and/or disposal systems).
- Requirements for leachate control system requirements at existing landfills may be satisfied by passive systems involving installation of properly designed final covers with leachate drainage systems. Passive leachate control systems may be utilized only under the following conditions:
    - when closure is imminent and no further disposal will occur; and

  - when leachate generation is minimized by the closure design and construction. Post-closure monitoring must document that there is no pollution or the threat of pollution at the site.

- Active leachate control systems (leachate pumping, groundwater pumping, etc.) may be required for existing landfills when:

  - the facility will remain an active landfill for several more years; or

  - the existing leachate contamination is significant and poses a threat to ground or surface water supplies.

B. Leachate Collection Piping Design Considerations

Leachate collection piping systems installed on a liner system should conform to the following:

- The expected efficiency of the leachate collection system should be calculated and submitted. The calculations should include the expected leachate quantities and the hydraulic head for a 25 year, 24 hour storm occurring during the first lift of landfilling, the middle lift of the phase and after final cover. Calculations for the above three scenarios should be based upon the average daily precipitation for the wettest month of the year.

- The bottom slope should be a minimum of 2%.

- Sufficient slope to provide a self-cleaning velocity within the pipe based on actual maximum flows from the area of drainage. The minimum flow velocity should not be below 2 feet per second based on full flow or half flow capacity.

- Gravity drainage of leachate to external storage or disposal facilities. Once leachate is directed to the low end of the lined area the leachate may be removed through use of a riser system or by passing the collection pipe through the liner to an external collection tank. Penetrations of the liner should be minimized and carefully sealed.

- Hydraulic head may not exceed 1 foot of leachate on the liner at the lowest point of the lined area, except during storm events.

- The maximum leachate flow distance should not exceed 150 feet, with 50 feet being a reasonable minimum.

- Trunk lines should be installed to have a minimum 1% slope.

- Lateral lines should be installed to intercept the flow and should have a minimum slope of ½%.

- Pipes should be surrounded with suitable stone capable of transmitting leachate flows should the pipes fail. At a minimum, the stone bedding should consist of 3/4 inch rounded washed stone.

- The drainage blanket should be designed and constructed to provide for transport of the leachate within the collection system to a central collection point for treatment and disposal.

- The piping material should possess adequate structural strength to support the maximum anticipated static and dynamic loads and stresses to be imposed on the pipe by the drainage layer, gravel pack, overlying wastes, and any equipment used at the landfill. The supporting strength of the pipe should be equal to, or greater than, the loads and stresses imposed on the pipe with a minimum safety factor of 1.5.

- The piping material should be slotted or otherwise perforated to provide for sufficient area for drainage. Design should insure that perforations will not be easily clotted by sediments or chemical precipitation or biological growth.

- Pipes should have a minimum diameter of 6 inches and a minimum pipe thickness of SDR 80, or schedule 80 for refuse depths of less than 50 feet. For depths of refuse greater than 50 feet the minimum pipe diameter should be 6 inches and the minimum thickness sufficient to accommodate the additional stress. The overburden pressure and pipe strength required to handle that overburden pressure should be calculated, allowing for a maximum ring deflection of 20%. An appropriate strength test for piping is ASTM D2412, Paragraph 6-9.

- The piping material should have a demonstrated chemical resistance to the wastes to which it will be exposed and the expected leachate to be produced within the landfill.

- The piping systems must be cleaned out before use.

- Piping system design should include sufficient clear out access for all collection lines. Generally clean out access points should not be more than 500 feet apart.

- Leachate collection lines should be in direct contact with the lowest point of vertical migration of leachate. Perforations should be near, but not at, the pipe invert to help maintain the lowest possible hydraulic head, but the invert should be solid to allow for efficient pipe flow at low volumes.

XIV. LANDFILL FINAL COVER SYSTEMS (CAPS)

A. Introduction

The purpose of a landfill cap is to minimize percolation of water into and through the landfill. This serves to minimize groundwater pollution should the landfill have no liner or leachate collection system, or to minimize costs associated with collection and disposal of leachate in landfills with liners. Costs of leachate collection and disposal during post-closure may range from 45 - 70 percent of total post-closure costs.

To remain effective landfill caps must be protected from erosion, cracking, freeze-thaw actions and other types of degradation. Sufficient soil cover and a well established vegetative layer assist in protection of the barrier layer. In addition, the vegetative layer serves to reduce the amount of water which percolates into the final cover by maximizing the evaporative transpiration of water.

Landfill final covers have the following functions:

- prevent or minimize percolation of rainwater into the landfill;

- suppress vectors;

- vent and control landfill gasses;

- promote site reclamation;
- promote aesthetics;
- promote drainage of precipitation;
- isolate solid wastes from the environment;
- accommodate settling and subsidence.

Landfill final covers should have the following attributes:

- resistance to wind and water erosion;
- resistance to slumping and cracking;
- resistance to slope failures;
- resistance to cold-weather freeze-thaw cycles;
- resistance to disruption by animals and plants.

B. Design Considerations

The following design features should be considered during closure of landfills and design of the final cover:

- the ultimate contours of the landfill;
- storm water controls such as ditches, drains and terraces, particularly with regard to prevention of erosion;
- vegetation suitable for the climate and type of cover soil, with consideration of planting and upkeep of that vegetation;

The following items should be considered in determining the final design of a landfill cap:

- the vegetative support protection layer must be thick enough to protect the cap;
- the cover should minimize degradation of the cap due to freeze-thaw cracking;
- the final cover must be designed to prevent root penetration and animal penetration of the cap layer;
- the cover design must take site settlement and consolidation into consideration.

XV. LANDFILL CAP - MINIMUM DESIGN REQUIREMENTS

As specified in the landfill regulations, the minimum design standards for landfill final cover systems require:

- a subgrade layer;
- a venting layer (minimum hydraulic conductivity of $1x10^{-3}$ cm/sec.);
- a low permeability layer with a thickness of at least 18 inches and a

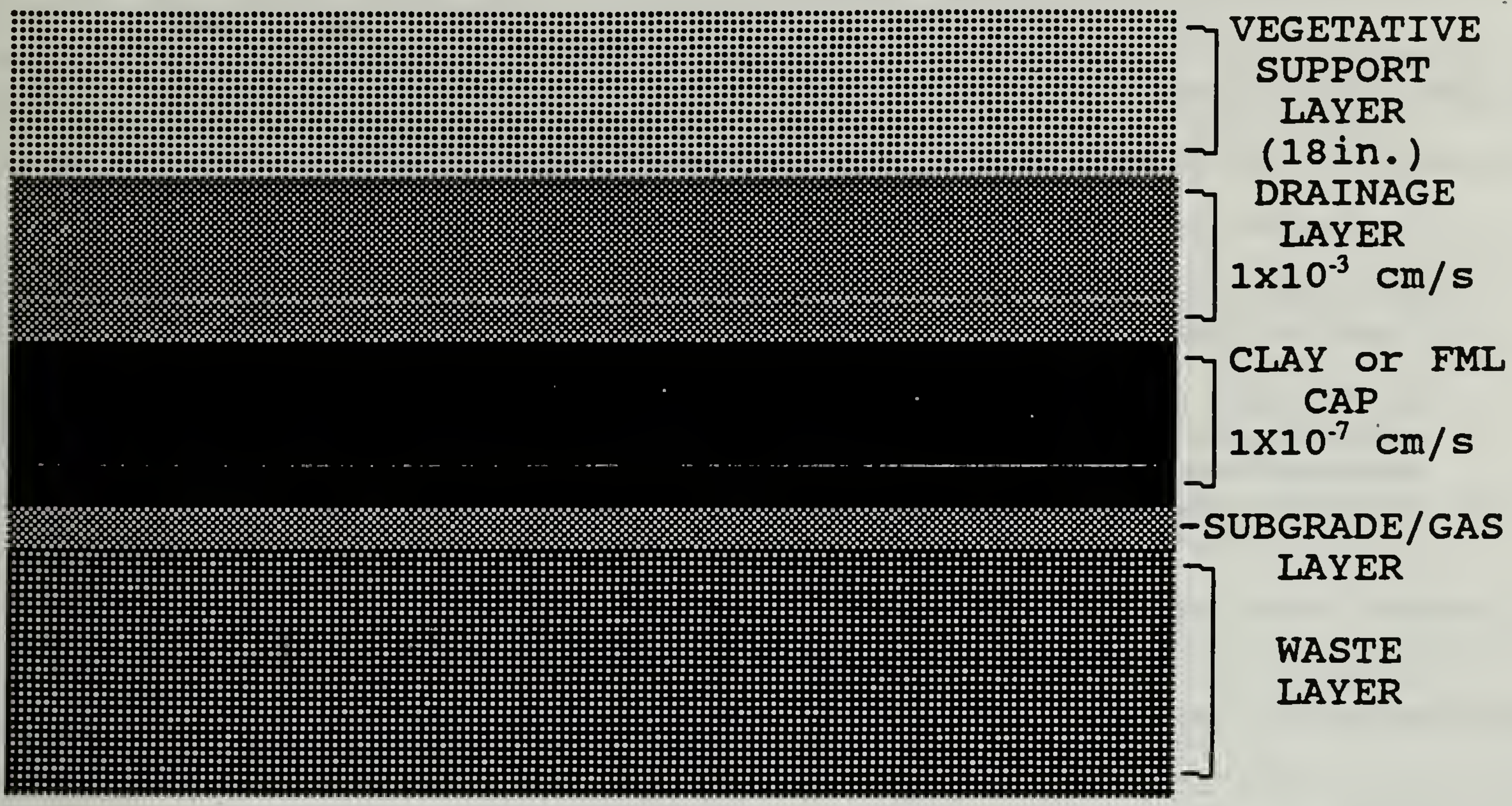
VEGETATIVE SUPPORT LAYER (18in.)
DRAINAGE LAYER $1x10^{-3}$ cm/s
CLAY or FML CAP $1X10^{-7}$ cm/s
-SUBGRADE/GAS LAYER
WASTE LAYER

Figure 1-2: Minimum Final Cover (Cap) Design

maximum hydraulic conductivity of $1x10^{-7}$ cm/sec or an approved FML. The cap should have a hydraulic conductivity no greater than the liner;

- a drainage layer consisting of either 6 inches of soil or a synthetic drainage net with a hydraulic conductivity of $1x10^{-3}$ cm/sec; and
- a vegetative support/protection layer with an overall thickness of at least 18 inches, of which at least 12 inches must be capable of supporting vegetation.

The regulations allow for alternative designs to be proposed as long as such designs offer equivalent protection. Alternative designs may use different thicknesses of materials and may use such devices as synthetic drainage nets in place of the typical sand or gravel drainage layers.

The cap should be constructed over a foundation layer capable of supporting the weight of the cap and against which a clay cap can be adequately compacted. The cap itself should be compacted to not less than 90% Modified Proctor, ASTM method D1557-70. The cap material should also be compacted at a moisture content wet of optimum as determined by the Modified Proctor test.

A. Design Considerations

1. Subgrade Layer

The subgrade layer should have the following attributes:

- be free of materials which could abrade or penetrate the low permeability cap;
- be of sufficient thickness and structural strength to support construction activity and provide for long-term final cover system integrity;

- be a minimum of 12 inches thick.

2. Gas Venting Layer

The gas venting layer should have the following attributes:

- a minimum hydraulic conductivity of 1×10^{-3} cm/sec;
- provide adequate filters above and below the gas venting layer if the layer is not self-filtering;
- vent pipes should be anchored to the barrier materials ensuring that a geomembrane is not torn should there be some differential settlement between the pipe and the geomembrane (This settlement should be minimized in the design, e.g. do not extend the vent pipe any deeper than necessary); and
- May have horizontal collection pipes.

3. Impermeable Layer

The final cover impermeable layer should meet the materials specification and construction considerations of the impermeable layers (both soil and FML) specified in the ground water protection system section of this guidance. Additional design considerations should include:

- the effects of consolidation and settlement on the layer;
- evaluation of freeze/thaw impacts; and
- determination of slope stability of this component, particularly the interface with other components of the final cover system.

4. Drainage Layer

This layer should include the design and construction considerations of the drainage layer used in the ground water protection systems. However, the hydraulic conductivity required is 1×10^{-3} cm/sec and not 1×10^{-2} cm/sec as specified for drainage layers over a liner. Design considerations should include:

- an evaluation of the potential for fines to migrate from the upper layer and a determination of the need for a filter between layers;
- a determination of the volume and discharge points of water transported by the drainage layer;
- an evaluation of the need to provide additional drainage capacity through addition of perforated pipes or other materials;
- an equivalency determination where synthetic materials are substituted.

5. Vegetation Support Layer or Topsoil Layer

The thickness of topsoil applied to the final cover affects the storage of water for use by plants. Greater thicknesses increase storage of water. This factor may result in greater leakage rates, but will also provide better conditions for vegetation and soil stability and decrease soil erosion.

Topsoil type directly affects runoff and evapotranspiration by controlling the rate of infiltration. Fine-grained topsoils have lower hydraulic conductivities; therefore, runoff is greater. In addition, infiltrated water remains nearer the surface for longer duration, providing greater availability for evapotranspiration. Fine-grained topsoils also have greater plant available water capacities (water storage) and capillarity which increase evapotranspiration.

Research indicates that it is preferable to have as dense a stand of grasses as possible to protect the final cover from erosion, maintain the moisture content of the topsoil, and to maximize evaporative transpiration from the vegetation. Therefore it is recommended that the vegetative support layer should be at least one foot thick or more in order to promote good root growth, to prevent penetration of roots into the clay cap layer, and to prevent freeze-thaw cracking of the cap. In addition, the thicker the vegetative support layer the greater the vegetative height and density, both of which promote evaporative transpiration.

The soil used for the vegetative layer of the final cover should be tested for pH, nutrients, organic matter content and bulk density. Soils should then be amended by adding fertilizers, lime and organic matter such as composted leaves or other materials to correct for deficiencies. Compacted soils should be scarified and amended with organic matter prior to seeding.

The vegetative support layer should:

- have a total thickness of 18 inches, the top 12 inches of which should be capable of supporting vegetation and the bottom 6 inches of which can perform as a drainage layer.

5. Vegetation Layer

Vegetation growing on the final cover results in decreased runoff and increases evapotranspiration and lateral drainage. Vegetation has little affect on percolation of water through the cover. Perhaps the most important objective of a good vegetative layer is the reduction in erosion of the cover.

The type of vegetation chosen for the final cover should be tolerant of the conditions to be found in a landfill environment such as methane gas in the root zone, thin soil cover (and therefore a shallow root zone), and dry conditions.

It is recommended that the planting of crops and mowing of the vegetation be discouraged as both practices lead to compaction of the vegetative support layer and reduction of ground cover. Mowing once per year may be necessary to control vegetative growth.

CHAPTER 2 CONSTRUCTION CERTIFICATION, QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

I. INTRODUCTION

A Quality Assurance, Quality Control (QA/QC) program must be implemented during construction of the facility to ensure that both the materials and the construction of the liner or final cover will meet the performance and design standards established in the Solid Waste Management Facility Regulations.

A Quality Assurance program consists of a planned system of activities performed by the owner of the facility to assure that the facility is constructed as specified in the design.

A Quality Control program consists of a planned system of inspections performed by the contractor to control the quality of construction.

A Construction Certification program consists of the affirmation by a qualified professional engineer that the facility construction has been completed under his general supervision in compliance with the approved design plans and specifications. Construction is documented through inspection, observation, oversight and testing methods and procedures.

II. REGULATORY REQUIREMENTS

A. QA/QC Program Components

A QA/QC plan must be submitted as a part of the landfill design plan. The QA/QC plan should provide the basis for the construction certification required by 310 CMR 19.106. At a minimum a QA/QC program is required for the ground water protection system, the environmental monitoring systems and the final cover system. A QA/QC program for other appurtenances may be required by the Department or submitted by the applicant under the applicant's own initiative, as applicable.

All recommended procedures established in this chapter should be included in the QA/QC plan, but may be supplemented by additional or alternative procedures recommended by the manufacturer of the materials or components used in construction of the facility.

A QA/QC program should address the following aspects of landfill construction:

- design specifications;
- construction/installation of each component of the liner or final cover;
- inspection activities;
- sampling and analysis activities for soils and geosynthetics;
- documentation of construction, inspection and sampling activities.

B. Role of the Certifying Engineer

Each phase of construction of a liner or cap needs to be carried out and inspected under the direction of the independent professional engineer who shall certify that each phase of construction was completed in accordance with approved plans and specifications.

Table 2-1: Construction Quality Assurance/Quality Control Program Components for Liner/Final Cover Construction.

- Qualifications and Responsibilities of Parties
- Chain-of-Command, Meetings and Reporting Structure
- Soil Components of the Ground Water Protection System or Final Cover System
    - Pre-construction testing of soil sources
    - Test fill construction and testing
    - Construction testing for material evaluation
    - Construction testing for performance properties
- Geosynthetic Components of the Ground Water Protection System or Final Cover System
    - Manufacturing
    - Fabrication
    - Handling, storage and transportation
    - Installation
    - Construction with other materials
- Documentation and Certification

C. Role of the Independent QA/QC Officer

To properly implement a QA/QC plan, a quality control officer under supervision of the certifying engineer should be at the site at all times during all phases of the construction of the landfill. This person should observe or perform and document all required inspections and sampling of the liner and final cover and other components of the facility and oversee all remedial construction activities.

A QA/QC Officer's qualifications should consist of:

- Engineering and/or training with "sufficient" practical, technical, and managerial experience in construction projects.

A QA/QC Officer's and/or Certifying Engineer's Role includes:

- review design criteria, plans, and specifications.
- educate QA/QC staff.
- schedule and support QA/QC activities and inspections.
- determine and certify that all materials and construction of the landfill adhere to approved design plans and specifications, including:
    - determining the initial and final grades of the landfill;
    - overseeing the installation and construction of all components of the liner or final cover;
- oversee the installation and completion of run-on and run-off controls, pumps, monitoring devices and other appurtenances.
- oversee material and equipment QA/QC testing and verify all data

generated through the testing program;

- ensure that as-built plans, where required, accurately reflect the constructed facility; and
- document all construction and QA/QC activities.

Many liner or final cover failures are attributed to a lack of adequate QA/QC testing and control during installation. The DEP will not authorize operations or approve the closure of a landfill until the owner demonstrates that the liner or final cover has been constructed in a way which meets the performance and design standards established in the regulations.

D. Role of the Liner Installer

The manufacturer of the liner material should be experienced in the installation of numerous liners and/or final covers. The company should have installed at least 10 million square feet of similar material.

Installation of liners and final covers should be carried out under the direction of a person with extensive experience in the installation of liners and final covers. Installation of FML materials should be under the direction of a person who has installed a minimum of 1 million sq. ft. of similar liner material.

III. QA/QC TESTING GUIDANCE FOR SOILS

A. Introduction

In order to ensure that a liner or final cover system is constructed and will perform as designed, several critical physical parameters of foundation soils and liner or final cover materials must be determined.

QA/QC testing of soil materials to be used either for a liner or a final cover must consist of two components. The first component consists of tests on the borrow source or sources for the soils to ensure that soils meeting the design requirements exist in sufficient quantity and with sufficient quality for the proposed application. The second component consists of tests on compacted soils to ensure that the in-place material meets the design standards. Tests on the in-place material may take two forms: laboratory tests on undisturbed samples removed from the compacted liner; and in-situ tests of the compacted liner.

QA/QC programs must incorporate both borrow source testing and in-place compacted liner testing to ensure that the low permeability soil layer will function as designed (See Tables 2-3, 2-4 and 2-5.)

B. Subgrade or Foundation Layer Testing

The subgrade layer for liners or final covers must be capable of supporting the weight of the fill material or the final cover and be structurally stable. For liners, subsurface investigations should be conducted to determine the suitability of underlying layers to support the proposed fill. It is recommended that the uppermost two feet of the subgrade be re-worked to ensure the material and density are adequate.

Foundation soils should be tested with methods established in Table 2-3. The foundation layer should be built in six inch compacted lifts. The foundation layer for a final cover should be the same as the final shape of the landfill and should be a minimum of 12 inches thick. Based on grain size analyses, it

Table 2-2: Elements of a Construction Documentation Report

Major Elements	Components
Engineering Plans	· Completed sub-base elevations · Final clay liner grades · Leachate collection lines, cleanouts, and manholes with spot elevation every 100 feet along the lines and at all manhole entrances and exits · Drainage features · All monitoring devices · Spot elevations at all breaks in slope and on approximate 100-foot centers · Document testing locations · Other site information as appropriate
Engineering Cross-Sections	· Minimum of one east-west and one north-south through the completed area
Comprehensive Narrative	· Explaining how construction of the project was accomplished along with an analysis of all soil-testing data obtained. This report should also include an appendix containing all the raw data from the field and laboratory testing
Series of Color Photographs	· Documenting all major aspects of site construction
Construction Certification	· Should be certified by a registered professional engineer to have been completed according to the approved plans. Any deviations from the plans should be noted and explained

Source: Gordon et al. 1984.

may be necessary to use a filter fabric between the foundation layer and any impermeable soil layer to prevent piping. In addition, the foundation layer must not consist of abrasive materials that would damage the FML where the FML will be in direct contact with the foundation layer. For example, solid waste combustion ash is not a suitable foundation material for FMLs due to its abrasive qualities.

C. Low Permeability Soil Borrow Source Testing

The borrow source or sources for low permeability soils intended for use as liners or final covers must be periodically tested for index parameters in order to ensure that a potential borrow source will provide sufficient material which meets the specifications for the liner or final cover. The

Table 2-3: In-Place Sub-Grade Layer Testing Requirements

Type of Test	Testing Method	Frequency (each 12" thickness)
Unconfined Compressive Strength	ASTM D 2166	1 test/acre
Direct Shear Tests	ASTM D 3080	1 test/acre
Triaxial Compression	ASTM D 2850	1 test/acre
Grain Size Analyses	ASTM D 421 ASTM D 422 ASTM D 1140	1 test/acre
Density		
(90% proctor)	ASTM D 698	5 tests/acre
(95% modif. proctor)	ASTM D 1557	

Department suggests that each borrow source be tested for index parameters at the frequencies indicated in Table 2-5. Site specific conditions at the borrow pit may indicate that more frequent testing should be required.

D. Low Permeability Soil In-Place Testing

Testing of compacted soils should incorporate both laboratory testing on undisturbed samples removed from the liner and in-situ testing using infiltrometers. Laboratory measured soil liner permeabilities will demonstrate hydraulic conductivities only for a very small sample area while in-situ tests using infiltrometers will provide a more accurate picture of hydraulic conductivities actually produced in the field over a larger surface area of liner. In-situ tests will provide a truer indication of whether the design standard of 1×10^{-7} cm/sec has been achieved since in-situ tests may measure hydraulic conductivities that are significantly larger than those measured using laboratory measurements. Table 2-4 presents recommendations for in-place testing of low permeability soils.

Guidance on soils testing includes the following:

- A QA/QC program to determine whether a soil liner meets the design standard for hydraulic conductivity should take into consideration the area of the liner in determining the minimum number of samples to take from the liner. Either a large area of the liner should be tested using infiltrometers or numerous undisturbed samples should be removed for laboratory testing.
- When nuclear methods are used to test in-place density and moisture content, a minimum of one sand cone test should be taken for each twenty (20) tests taken using nuclear methods. A minimum of one sand cone test

Table 2-4: In-Place Testing Requirements for Low Permeability Soils (Each Lift Unless Otherwise Noted).

Type of Test	Testing Frequency	Testing Method
In-place Density and Moisture Content	5 tests/acre	ASTM D 1556 or ASTM D 2922 and ASTM D 3017
Undisturbed permeability (Triaxial Cell Method with back pressure)	1 test/acre	U.S. Army Corps of Engineers Manual, EM 1110-2-1906 Appendix VII Permeability Tests
Atterberg limits (liquid limit and plasticity index)	1 test/acre	
Grain size (to the 2 micron particle size)	1 test/acre	
Moisture-density curve (as per clay borrow requirements)	5,000 yd^3 and all changes in material	

should be taken for each day of work at the site to confirm the results of nuclear methods.

- When the triaxial cell method is used to measure undisturbed permeability the confining stress applied to the sample should be no greater than that present in the field.

- The generally preferred method of removing undisturbed samples of compacted soils is with a Shelby tube.

E. Drainage/Protection Layer Testing

Minimum testing requirements for granular drainage/protection materials for liners or final covers are as established in Table 2-6.

F. Checklists

The EPA manual entitled "Seminars - Design and Construction of RCRA/CERCLA Final Covers" contains checklists of important geotechnical and construction parameters for impermeable soils and other soils used in final cover and liner systems. These checklists can be used for recording and reporting information relative to construction of final cover and liner systems.

Table 2-5: Borrow Source Low Permeability Material Testing Requirements

Type of Test	Testing Frequency*	Testing Method
Grain size	2,000 yd^3	ASTM D 422
Moisture content	2,000 yd^3	ASTM D 2216
Moisture-Density curve	5,000 yd^3	ASTM D 1557
Atterberg limits (liquid limit and plasticity index)	5,000 yd^3	ASTM D 423 and ASTM D 424
Lab permeability (triaxial cell method with back pressure)	10,000 yd^3	U.S. Army Corps. Engineers Manual, EM 1110-2-1906 Appendix VII Permeability Tests

* Tests should be conducted at the established testing frequency or any change in material

Table 2-6: Granular Drainage Material Testing Requirements

Type of Test	Testing Frequency	Testing Method
Grain size (to the #200 sieve)	1,500 yd^3	ASTM D422
Permeability	3,000 yd^3	ASTM D2434
Bearing Ratio		ASTM D1883

IV. QA/QC TESTING GUIDANCE FOR GEOSYNTHETIC MATERIALS

A. FML Liner Testing

As with a QA/QC program for soils a QA/QC program for installation of FMLs must include a quality control component for the FML material and a quality assurance component for installation of the FML. The manufacturer of the FML material should maintain detailed quality control documentation and be able to provide certification of the quality of all delivered materials. Delivered materials should be carefully inspected to ensure that materials have not been damaged in transit or during storage at the landfill site.

Installation of the FML should be overseen by a person experienced in installation. Frequent seam testing must be done to ensure the integrity of the installed material. In-place QA/QC requirements should include the following:

- the liner material should be continually inspected for uniformity, damage, and imperfections such as holes, cracks, thin spots, or foreign materials. Immediately after installation and seaming the liner should be inspected to ensure the absence of tears, rips, blisters, or punctures. Any imperfections should be immediately repaired and reinspected;
- all field seams must be quality tested after they have been allowed to develop to full strength according to appropriate techniques for the type of seaming procedure used;
- 100% of seams should be tested with either a vacuum box or pressure tested (double weld seams);
- destructive seam tests for peel and shear strength should be done a minimum of every 200-300 feet of seam, but not less than 3 times per day, including the beginning, middle, and end of each work day.

Synthetic Drainage Material or Geonet Testing

Geotextiles and geonets should be tested so as to determine:

- Equivalent opening size
- Hydrostatic bursting strength
- Tearing strength (trapezoidal)
- Compression behavior/crush strength

B. FML Checklist

All FMLs used in liner and cap installations should be inspected and necessary installation testing completed in accordance with the manufacturer's requirements. Documentation of FML QA/QC testing should be included with the as-built records submitted to the Department.

The EPA manual entitled "Seminars - Design and Construction of RCRA/CERCLA Final Covers" contains typical manufacturer's requirements for installation of a High Density Polyethylene (HDPE) FML. This is presented as a sample of the type of QA/QC associated with FML installation.

Table 2-7: Test Methods for Use With Geotextiles in Filter or Drainage Applications

Material	Test to Determine	Test Method
Geonet	Transmissivity	ASTM D4716
Geotextile	Permittivity	ASTM D4491
Geotextile	Apparent Opening Size	ASTM D4751
Geotextile	Gradient Flow	CW-02215[*]
Geotextile	Long Term Flow	GRI-GT1[**]

[*] Corps. of Engineers Test Method
[**] Geosynthetic Research Institute Test Method

CHAPTER 3 SURFACE WATER MANAGEMENT

I. INTRODUCTION

Storm water management refers to all measures incorporated into a landfill design and operation to control and manage storm water run-off and run-on.

Storm water run-off and run-on is generated from precipitation. Run-on refers to storm water that originates outside of the subject area and then, because of surface grades, flows onto the subject area. At landfills run-on generally originates outside of the filled area and then flows onto the landfill. This most commonly occurs when the landfill is operating below the surface grade of the surrounding area. Run-on control is also necessary to prevent storm water from elevated portions of the landfill from flowing onto lower phases where the active filling may be occurring. Run-off refers to precipitation that falls onto the landfill proper and then needs to be controlled to prevent erosion or transport of materials or impacts to surrounding areas as it runs-off the landfill. Surface water management is often interchanged with and means the same as storm water management or storm water controls.

Surface water and ground water protection refers to all measures instituted to protect surface water bodies - ponds, rivers, streams, wetlands, etc - and ground waters from contamination, including control of erosion. Surface water run-off from landfills can potentially contaminate surface water bodies and/or groundwater if not managed properly.

This chapter serves as an introduction to the issues involved in storm water control. Performance goals for landfill management of storm water run-on and runoff will be discussed. Methods to obtain these goals are presented in a section with brief descriptions of storm water control methods, followed by design standards for landfill storm water control systems. The chapter concludes with a discussion of state and federal regulations relating to landfills and storm water.

II. PERFORMANCE GOALS

Design of landfills shall incorporate controls for the management of storm water run-on and run-off, during the construction, active life and closure/post closure period. Run-on and run-off shall be controlled in order to:

- Maintain the integrity of the landfill by preventing erosion of the liner, fill material or cover material [310 CMR 19.115, 19.130(20)];

- Minimize the quantity of water running onto the filled areas to minimize leachate production by preventing ponding and the infiltration of water into the fill [310 CMR 19.115, 19.130(19)];

- Minimize the transport of contaminants, either in suspension or solution, from the landfill onto adjacent areas or surface water bodies or ground water.

III. STORM WATER CONTROLS

A number of potential storm water controls (or Best Management Practices - BMP's) are available to be used in addressing the variety of run-on and run-off conditions. This section defines the types of controls and purpose for which they can be used.

Storm Water Management Plan: A storm water management plan should include all measures needed to achieve the goals as stated above. In particular a storm water management plan needs to address the requirements of the facility specific to the various stages of landfill development. These stages include construction (liner and final cover) active areas (i.e. ongoing landfilling), and long term maintenance areas (i.e. intermediate and final cover).

Land Grading: Is the reshaping of the ground surface to planned grades as determined by engineering survey, evaluation and layout. It is used to provide more suitable topography for final cover materials, to control surface water runoff and to minimize soil erosion and sedimentation control practices.

Surface Roughening: Is the roughening of bare soil surface with horizontal grooves running across the slope, stair stepping, or tracking with construction equipment. It is used to aid the establishment of vegetative cover from seed, to reduce runoff velocity and increase infiltration, and to reduce erosion and provide for sediment trapping.

Temporary Seeding: Is the planting of rapid-growing annual grasses, small grains, or legumes to provide initial, temporary cover for erosion control on disturbed areas. It is used to temporarily stabilize denuded areas that will not be brought to final grade for a period of more than 30 working days. Temporary seeding controls runoff and erosion until permanent vegetation or other erosion control measures can be established.

Permanent Seeding: Is the control of runoff and erosion on disturbed areas by establishing perennial vegetative cover with seed. It is used to reduce erosion and decrease sediment yield from disturbed areas, and to permanently stabilize such areas in a manner that is economical, adapts to site conditions, and allows selection of the most appropriate plant materials.

Rock Riprap: Is a layer of stone designed to protect and stabilize areas subject to erosion. It is used to protect the soil surface from erosive forces, and to improve stability of soil slopes that are subject to steepness, seepage or have poor soil structure.

Diversions: A temporary or permanent ridge or channel or combination of the two constructed on a designed grade across sloping land. It is used to protect work areas from upslope runoff, to divert sediment-laden water to appropriate traps or stable outlets, and to divert water from areas where it is in excess to locations where it can be used or released without erosion or flood damage.

Diversion Dike: Is a dike or dike and channel constructed along the perimeter and upslope of a disturbed construction area. It is used to prevent storm water runoff from entering a work area, and to prevent sediment-laden water from leaching the construction site.

Grass-Lined Channel: Is a channel with vegetated lining constructed to design cross-section and grade for the conveyance of runoff. It is used to convey and dispose of concentrated surface water runoff without damage from erosion, deposition, or flooding. Riprap and paved channels can be used to provide the same function.

Level Spreader: Is a non-erosive outlet for concentrated runoff constructed to disperse flow uniformly across a slope. It is used to convert concentrated flow to sheet flow and release it uniformly over a stabilized area.

Temporary Sediment Trap: Is a small temporary ponding basin formed by an embankment or excavation to capture sediment. It is used to detain sediment laden runoff and trap the sediment to protect receiving streams, lakes, drainage systems, and protect adjacent property.

Sediment Basin: Is an earthen embankment suitably located to capture sediment. It is used to retain sediment on the construction site and prevent sedimentation in off-site streams, lakes and drainage ways.

Detention Pond: Is an earthen embankment or excavated pond whose main purpose is the temporary detention of storm water to control peak runoff rates and for the settlement of particulate pollutants. It is used as an effective means of removing pollutants such as sediments, phosphorus, organic matter, trace metals and hydrocarbons by settling; and controlling downstream bank erosion due to reduced velocities.

Retention Pond: Is an earthen embankment or excavated pond that usually contains a permanent pool whose main purpose is the retention of storm water runoff and settlement of particulate pollutants. It has a high removal rate of sediment, BOD, organic nutrients and trace metals, and can remove soluble nutrients through the use of aquatic plants and algae.

Infiltration Trench or Basin: Is a trench or basin containing coarse stone or sand and gravel whose main purpose is temporary storage of storm water runoff. It is effective at removing soluble and particulate pollutants, and can increase groundwater recharge.

Vegetated Swale: Is a grassed water course whose purpose is to retard or impound concentrated runoff to induce infiltration and decrease velocity. It reduces water velocity and controls direction of flow. It provides additional area for infiltration and provides moderate removal of particulate pollutants during small storm events.

Sediment Fence: Is a temporary sediment barrier consisting of filter fabric buried at the bottom, stretched and supported by posts. It is used to retain sediment from small disturbed areas by reducing the velocity of sheet flows to allow sediment deposition.

IV. DESIGN STANDARDS

The following design standards are recommended for use in properly managing storm water at sanitary landfill sites.

- Run-on and run-off controls should be designed for, at a minimum, the peak discharge of a 24 hour 25 year storm.

- Drainage structures must be designed and maintained so as to minimize the effects of differential settling and to prevent undermining

- Side slopes shall not exceed a slope of 3 horizontal to 1 vertical (3:1). Final top slopes shall be a minimum of 5%. Daily and intermediate slopes may be at other grades as justified by design.

- Terraces should be installed in side slopes for every 15-25 vertical feet of fill. Terraces should be wide enough to accommodate equipment needed for maintenance and repair.

- Erosion should be limited to 2 tons/acre-year

- Methodology (to include assumptions, formulas, and defined terms), analysis and calculations should be submitted as documentation for design basis of the storm water management systems.

A. Active Area

The active portion of the landfill is defined as that part of the landfill that has not received intermediate or final cover. The Department believes that the active portion of landfill, which only has daily cover, represents the area where, potentially, the worst adverse impacts form poor storm water control can occur. These include erosion (cover and solid waste), contact of surface water with the solid waste or leachate outbreaks and subsequent transport off site of contaminants in solution or suspension, and infiltration of storm water into the fill resulting in leachate generation.

Run-on can usually be effectively controlled through the placement of berms to direct water away from the active area or with operational controls such as the progression of cell and row development and maintaining proper grades to promote drainage. In particular the active face (area of daily disposal activity) needs to be protected from run-on so that daily operations are not hindered and because the active face (which usually doesn't have any cover material until the end of the day) will readily allow the infiltration of water into the landfill.

Selection and grading of materials used for daily cover should be the primary means to control adverse effects of run-off from the active portion of the landfill. Grading should promote sheet flow of run-off water and prevent uncontrolled channelling which may promote erosion of the cover soils or the solid waste. Flow should be directed as much as possible away from the active area (or other unstabilized areas) to stabilized slopes or conveyance devices such as erosion proof swales or pipes.

Control of surface water run-off from the active portion of the landfill is intended to prevent or minimize discharge of contaminated run-off to any surface water or ground water and minimize erosion. To comply with this requirement monitoring the surface water run-off from the active portion of the landfill may be required.

If monitoring results reveal that the run-off from the active perform is above acceptable levels the Department may require collection and treatment of this run-off. Generally, acceptable levels will be established in the permit review process.

Surface run-off water contaminated above levels established by the facility permit may require instituting control and/or treatment provisions. Control/treatment may include a range of options from sedimentation basins for suspended solids removal to collecting and treating the run-off water to remove chemical or biological constituents. If contaminated run-off is intended to be added to the leachate collection system that system needs to demonstrate that it has the capacity to handle this flow.

B. Long Term Maintenance

Run on/run off control on portions of the landfill that have intermediate or final cover are primarily aimed at long term stabilization and erosion control of the cover materials and control of volume, velocity, locations and sediment load of the surface run-off discharges. Slope angle, slope length, vegetation, terracing and sedimentation-detention basins, stable water conveyance structures (swales, culverts, pipes, etc) and energy dissipators are central elements in preventing erosion and controlling volume and velocity.

C. Design plans and Reports

Solid Waste Regulation 310 CMR 19.000 requires that the basis for storm water controls at the active portion of the landfill be a 24 hour, 25 year storm event (19.115). It is recommended that the design basis for storm water controls on other parts of the landfill also be a 24 hour, 25 year storm event. When wetlands are associated with the facility, the 24 hour 100 year storm should be used as the design basis.

The design report for the storm water management plan needs to identify the design method used as the basis for the proposed run-on/run-off control system. Usually a water balance approach is used to define the problem. The water balance equation is:

run-off = precipitation + run on -infiltration - surface storage - evaporation/transpiration.

Methodology and calculations need to be submitted to justify the chosen design. Commonly used methods for run-off modeling are the Soil Conservation Services (SCS) Method, the Rational Method and the Hydrologic Evaluation of Landfill Performance (HELP). The citation for these methods can be found in the references at the end of this chapter.

The design report should evaluate run-off and run-on controls for at least the following 5 stages of the landfill development.

1.) Construction considerations during liner construction.

2.) During initial landfilling in new phases or sections.

3.) At mid life of the landfill during interim development of a phase. Preferable when the largest amount of active area is exposed.

4.) Construction considerations during final cover and closure activities.

5.) Post closure.

Calculations and analysis need to include the volume, velocity, and discharge locations and/or fate of the run-off water off site. Impacts to the surrounding properties and effects on local drainage basin need to be evaluated. A plan sheet delineating drainage routes, flow patterns and areas off site receiving the run-off needs to be provided. Engineering details of all run-on/run-off control measures including water ways, swales, ditches, terraces, pipes, etc. need to be provided.

Generalized erosion of cover material from the landfill is a common and persistent problem. The Department recommends a design goal of limiting erosion to less than 2 tons/acre-year. The Department strongly recommends and good engineering practice supports, that terraces/benches be incorporate into design of all side slopes. Placement of terraces/benches is recommended at a frequency of every 15-25 feet of vertical elevation change depending on slope steepness, slope length, type of soil, and volume of water from the top slope that may enter the side slope. Terraces should be built with reverse slope, with a minimum of 1 foot depth and should have a gradient of 1-2% to stable down slope conveyance outlets. Terraces should be wide enough to accommodate necessary maintenance equipment.

Stable outlets that go down side slopes need to be carefully designed. Undermining of these structures needs to be prevented. Energy dissipaters need to be provided at the discharge of all down slopes outlets and at all locations where velocity in the conveyance structure may cause erosion.

Rapid stabilization of slopes is a primary to surface water management systems. Vegetation is an effective tool in slope stabilization. The use of mulches, compost, fertilizers and hydroseeding is encouraged for establishing and maintaining vegetation. Vegetation should not be used solely for final covers but is recommended for use on intermediate slopes as well. Other methods to stabilize slopes include the use of stone mulches and synthetic and natural fiber erosion control mats.

Unstabilized slopes, such as daily, intermediate, and final slopes before being stabilized by vegetation or other means, generally represent areas most susceptible to erosion. These slopes should be protected from run-on, the most common source of which is from the top slope of the landfill, to minimize the volume of water flowing down these slopes. Temporary diversion structures, such as berms along the top of the slope, can be used to direct water to stabilized slopes and/or stable down slope conveyance structures. Additional temporary slope protection may be needed along the length of slope to control erosion such as terraces, berms, erosion mats or synthetic covers.

Maintenance requirements of all storm water control structures should be incorporated into the standard operating procedures for the landfill. The operation and maintenance report should identify the procedures and frequency that storm water management structures should be inspected, tested, cleaned or otherwise maintained to ensure proper functioning.

The O & M report should also contain the testing parameters, frequency and sample collection requirements, if any, for the monitoring of run-off water from the active area.

Engineering design plans should include:

A. Design Report
1.) A report containing a description of all intended storm water management methods with calculations and analysis supporting the proposed design.

B. Engineering Plans
1.) A plan sheet showing volumes, flow directions and discharge locations of all storm water.

2.) A plan sheet of engineering details, in plan view and sections, of typical surface water control structures such as swales, sedimentation basins, down slope water conveyances, rip rap etc.

C. Construction Specifications
1.) Sufficient description and details showing methods and materials for constructing the storm water control system and

2.) Description of methods employed to control storm water during construction.

D. Operation and Maintenance Manual
1.) Identify all procedures and schedules needed to maintain the storm water control structures.

2.) Identify run-off and storm water monitoring locations, frequency and parameter testing requirements.

V. REGULATIONS

Control of storm water is regulated by the DEP's Division of Water Pollution Control, Division of Wetlands and Waterways as well as by the Division of Solid Waste Management. This section will discuss the regulatory procedures for these divisions, and those of the Environmental Protection Agency. The applicability of each of these regulatory groupings should be considered in designing the landfill closure system.

A. Division of Solid Waste Management

The Division of Solid Waste Management's landfill regulations (310 CMR 19.000) address storm water management in the following sections.

Storm Water Controls, Section 19.115: Is the general performance requirement to prevent erosion or pollution from landfilling (from the initial phase through post-closure). Guidance on BMP's also specify that design requirements for active portions of the landfill control and collect a 24 hour - 25 year storm. This is the also required under RCRA Subtitle D Section 258.25.

Surface and Ground Water Protection, Section 19.116: Prevents the discharge of contaminated runoff or leachate to surface water or groundwater. It also addresses the Division of Water Pollution Control's NPDES point source discharge permits, and non-point source pollution control.

Top Slope and Side Slope, 19.130(18): Requires a minimum top slope of 5% and a maximum side slope of 3:1.

Storm Water Drainage, 19.130(19): Requires storm water controls to promote drainage off the landfill, minimizing ponding and prevention of run-on through use of diversion structures, ditches, channels, etc.

Erosion Control, 19.130(20): Requires the prevention of erosion of daily, intermediate or final cover, the prevention of siltation off-site, the prevention of solid waste or leachate migration off-site, and the replacement or repair of cover material as needed when damaged by settlement of erosion.

B. Federal Regulations

The federal government addresses the problem of storm water run-off in two different regulations. It is addressed indirectly in the Resource Conservation and Recovery Act (RCRA) Subtitle D, the section dealing with solid waste. Storm water is specifically addressed by amendments to the Clean Water Act, 40 CFR 122, which establishes permits under the National Pollutant Discharge Elimination System (NPDES). Certain sanitary landfills will be regulated by the NPDES and will have to apply for permits.

RCRA Subtitle D requires that landfills be designed to prevent run-on to the active portion during peak discharge of a 25-year storm. Owners or operators of landfills are also required to "design, construct, and maintain a system to control run-off from the active portion of the landfill [which must] collect and control, at a minimum, the water volume resulting from a 24-hour, 25-year storm." In a clarification, the EPA stated that the collected run-off "be handled in accordance with the requirements of the Clean Water Act including, but not limited to, the NPDES requirements."

The Clean Water Act (CWA) protects surface waters of the U.S. from storm water pollution with the following general provisions:

- Non-point source discharges will be controlled through implementation of the statewide management plan mandated by Section 319 of the Clean Water Act.

- Point source discharges of pollutants into the waters of the U.S., including wetlands, that violate any requirements of the CWA, including but not limited to NPDES requirements, are also prohibited.

The specific purpose of the NPDES regulations is to protect the surface waters of the United States from pollution contained in run-off. The primary targets of regulation under NPDES are municipal storm sewer systems and areas of industrial activity. Facilities that are regulated under NPDES will have to file one of three types of permits: individual, group, or general. Individual and group permits will describe present storm water control practices, characterize the amount and quality of run-off - including testing run-off for contaminants - and propose a management program. Group permit applications can be filed by a number of similar facilities, with only ten percent required to file complete permit applications to represent the entire group. General permits will be designed by the EPA in the near future, and will be tailored to specific industry types to make filing simpler. Sanitary landfills will probably be included in a general permit.

Sanitary landfills are regulated under NPDES as follows:

Landfills that accept industrial wastes will need to file NPDES permit applications. As mentioned previously, the NPDES regulates "areas of industrial activity." In addition to the sites on which industrial activities are carried out, landfills that accept the wastes from regulated industries are also required to file NPDES permit applications. Industrial wastes are defined as materials received from the following industrial activities:

> Lumber; paper mills; chemical; petroleum; rubber; leather tanning and finishing; stone, clay, and concrete; metal; enameled iron and metal sanitary ware; ship/boat manufacturing facilities; active and inactive mining and oil and gas operations; steam electric power generating facilities; sewage or wastewater treatment; food; tobacco; textile; apparel; wood kitchen cabinets; furniture; paperboard containers and boxes; converted paper/paperboard products; printing; drugs; leather; fabricated metal products; industrial and commercial machinery and computer equipment; electronic equipment; transportation equipment; measuring, analyzing, and controlling instruments; photographic, medical, and optical goods; watches and clocks; and glass.

Certain landfills that accept industrial waste will be exempted from NPDES permit applications. To qualify for this exemption the landfill must:

- be owned or operated by a municipality with a population of less than 100,000; and

- have a run-on / run-off control system as defined in RCRA.

However, EPA reserves the right to require landfills in full compliance with RCRA to obtain an NPDES permit if the landfill is considered a significant contributor of pollutants to US waters or contributes to a violation of a water quality standard.

In addition to industrial activity, NPDES regulates construction activity, which may produce run-off equally damaging to water quality. The broad language includes all construction activity except for disturbances of less than 5 acres of total land area which are not part of a larger common plan of development or sale. This definition includes most sanitary landfills. EPA officials state that this rule has not so far been applied to landfills, but the law as written could in the future be interpreted to require even landfills that do not receive industrial wastes to file NPDES permit applications.

The following table lists the regulations which apply to storm water, how it would be applicable to the operation, closure or post-closure use of a sanitary landfill, what permit would be issued and who would issue it.

Regulation	Landfill Application	Permit Required
Clean Water Act		
A. Storm Water Regulations (40 CFR 122). Individual, Group, or General Permit	New Construction totalling > 5 acres or Active portion if accepts industrial waste and serves community > 100,000 and no approval under RCRA Subtitle D	NPDES permit issued jointly by EPA and DWPC
B. Point source discharges (CWA section 402)	Detention / sedimentation basins. Long term cover, intermediate, final, and post closure	NPDES permit issued jointly by EPA and DWPC or possible DWPC permit if discharge to groundwater
C. Non-point source discharges. State or area wide water quality management plan	Prevent erosion and/or other impacts to surface water bodies from landfills	None
Wetlands 310 CMR 10.00	Limit destruction of wetlands during construction and closure of landfill. Prevent/minimize impacts to wetlands from storm water discharges. Minimize effects on flood control and storm storage	Order of Conditions Local Conservation Commission
RCRA Subtitle D 40 CFR 258		
258.25 Run-on runoff	Active portion of landfill (not intermediate or final cover) collect and control 24-hour 25-year storm	DSWM (Approved State Program)
258.27 Surface water requirements NPDES	Prevent impacts to surface water	DSWM (Approved State Program)

Solid Waste Regulations
310 CMR 19.000

19.115 Storm water controls	General performance requirement to prevent erosion or pollution from landfilling, initial phase through post closure. Guidance on BMP. Also specifies design requirement for active portion of landfill: control and collect 24-hour 25-year storm. RCRA D 258.25	DSWM
19.116 Surface and groundwater protection	o Prevent discharge of contaminated runoff or leachate to surface water or ground water o NPDES and DWPC point source discharge permits o DWPC non-point source pollution control requirements	DSWM
19.130(18) Top slope and side slopes	Minimum top slope = 5% Maximum side slope 3:1	DSWM
19.130(19) Storm water drainage	o Promote drainage off landfill, minimize ponding and prevent run-on. o Diversion structures: ditches, channels, etc.	DSWM
19.130(20) Erosion control	o Prevent erosion of daily cover. o Prevent siltation off-site. o Prevent solid waste or leachate migration off site. o Replace/repair cover as needed due to settlement or erosion.	DSWM

CHAPTER 4 ENVIRONMENTAL MONITORING PROGRAM

I. INTRODUCTION

A landfill's environmental monitoring program should be considered as integral a part of operations as refuse compaction or daily cover. It is important to properly monitor the local environment around the landfill to ensure early detection of any environmental problems that may occur. Conversely, a good monitoring program can provide an operator with reliable documentation of a groundwater protection system's effectiveness as well as information to relevant to potential health effects historically associated with landfills.

To develop an adequate and successful monitoring program, a full environmental assessment must be performed to meet the performance and design standards as specified in 310 CMR 19.118. The groundwater, surface water, leachate and air monitoring programs are designed during the assessment/facility design process. Chemical parameters of concern are determined and a sampling frequency is established. Chapter 5 of this document describes the assessment process and its value in more detail. Each of the environmental monitoring programs is discussed separately in the sections that follow.

II. GROUNDWATER AND SURFACE WATER MONITORING PROGRAMS

A. Groundwater Monitoring System

A groundwater monitoring program consists of a monitoring well network, sampling schedule, analytical list and quality assurance/quality control plan. Sections 19.118 and 19.132 of the regulations establish the minimum requirements for each of these components.

The monitoring network consists of a sufficient number of monitoring wells and piezometers necessary to detect releases of contaminants to the environment and to characterize the groundwater flow regime. Section 19.118 specifies that a minimum of one upgradient well or cluster of wells and three downgradient wells or cluster of wells cluster are required as groundwater monitoring points for a landfill. Rarely, however, is this number sufficient to characterize the site hydrogeology or provide an adequate early detection system for contaminant releases to the environment (19.118 (2)(a)2. Landfills often cover numerous acres and/or reside in areas of complex hydrogeology necessitating the installation of more than the required minimum to meet the Department's requirements.

To help ensure that the number of wells installed are sufficient, but not excessive, the monitoring system must be developed during the ISA and installed during the CSA. It is important to design a monitoring network in the context of a site assessment to ensure proper placement of monitoring equipment. If the wells are properly placed, they will be unable to provide appropriate data on site hydrogeologic conditions. The improperly placed wells would ultimately have to be abandoned and replaced, a costly and unnecessary task.

B. Surface Water Monitoring System

As with the groundwater monitoring system, the surface water monitoring system will generally be established during the CSA based on data collected during the ISA. Surface water monitoring will be necessary:

1. When a surface water body or stream exists on-site in an area likely to receive either surface water run-off from the landfill or potentially contaminated groundwater discharge.

2. Where there is significant reason to suspect that an off-site surface water body is/may be affected either from potentially contaminated surface water or groundwater from the landfill site.

As with groundwater, when designing a surface water monitoring program, both the upgradient and downgradient water quality must be determined. This is necessary to establish that the source of contamination is not upstream of the site. A limited number of sediment samples should also be collected to compliment the surface water sampling data.

C. Parameters

Once the ISA is complete, the monitoring wells have been installed, surface water monitoring locations established, and the analytical and QA/QC program established, the groundwater and surface water monitoring programs can be initiated. The parameters included in the programs should be proposed based on the results of the ISA. However, there is a minimum list of parameters that must be included in these monitoring programs. These parameters can be found in the regulations 310 CMR 19.132 (1)(h).

In addition to chemical analysis, groundwater and surface water elevation readings are collected as part of these monitoring programs. This information should be collected and recorded immediately prior to sample collection.

D. Schedule

Section 19.150 of the regulations requires quarterly sampling at least for the first year to establish background conditions. There are several reasons for this:

1. The contaminant concentrations vary throughout the plume and the groundwater and surface water systems are dynamic. The analytical results will therefore vary with time as the groundwater or surface water flows past the sampling point.

2. There are several points in the sampling and analytical process where the integrity of a sample may be compromised, thereby affecting the final analytical results obtained. These include: variation in sampling methodology or sampling personnel, analytical error, and improper decontamination techniques in the field between sampling stations to name a few. Proper QA/QC and strict adherence to standard operating procedures will limit the occurrence and effect of the above, however some combination of the above will likely occur during the monitoring program.

3. Groundwater elevations typically vary from season to season. Groundwater is highest during early spring, and lowest in early fall. This fluctuation can result in the modification of groundwater flow direction. It can also affect concentrations detected in samples. Contaminants present at higher concentrations in some soil horizons may or may not be present in the groundwater depending upon whether or not the groundwater intercepts the contaminated strata.

It is necessary to have more than one round of sampling and analytical data to develop the groundwater and surface water monitoring programs. As noted above, there are too many variables inherent in the sampling and analytical process to rely on only one or two sampling events. Once a baseline is established and site conditions are understood, the sampling frequency may be reduced. The larger database will help normalize the aberrant values produced by faulty or time dependant data.

E. Reporting

The analytical results must be submitted to the Department within 60 days after the sampling event (310 CMR 19.132 (1)(f)). The sampling schedule will be specified in the permit. The submittal package must include:

1. The analytical data sheets completed by the laboratory. These sheets should include all relevant information regarding the sample and sampling and analytical process such as analytical method number, the sampling date, extraction date, and preservation method. (Analytical data sheet requirements are specified in more detail in the outline guidance found in the appendix.)

2. A site map with groundwater elevations plotted and contoured. Surface water elevations should also be plotted and contoured where relevant.

3. A separate site map should indicate all sampling locations and relative levels of contamination present.

4. All analytical data organized into an easily understood/read format.

5. A letter report briefly summarizing and interpreting the results of the sampling event. The interpretation should discuss and attempt to explain any unusual results or apparent trends in the data. The report should also discuss things of note observed during the site visit such as leachate seeps, monitoring equipment in need of repair, deviations from the regular sampling program, or QA/QC problems. Any problems with monitoring equipment noted in the report must be corrected prior to the next scheduled sampling event.

6. Chain of custody information should also be submitted to the Department.

If the results indicate compounds exceed the state drinking water standards or MCL's, the Department must be notified within 14 days of the finding, 310 CMR 19.132 (i)(1). At that time the need for additional analysis will be determined. In general, additional analysis will be required when a standard is exceed for the first time, or when a significant change in contaminant profile trends is detected. Also, re-sampling will only occur in the wells that yielded those samples, unless it is determined that field or laboratory error caused the elevated readings. In that case, it may be necessary to re-sample all monitoring points. The Department will review the information and make a determination on the need for a comprehensive site assessment and corrective action.

III. LEACHATE MONITORING PROGRAM

A. Leachate Monitoring System

The Department requires monitoring of leachate on a site by site basis. (19.132(3)) As with the previous monitoring systems, leachate sampling and analysis should be part of the CSA. The analytical results are often used to aid in the design the groundwater and surface water analytical program. Comprehensive analysis of leachate can be compared to groundwater and surface water analysis and possibly be used to predict worst case conditions in groundwater and surface water quality.

The leachate monitoring system should include samples from seeps around the landfill as well as samples from the leachate collection system (if present). When identifying sampling locations, an effort should be made to include each "type" of leachate produced by the landfill. If there are seeps emanating from several locations around the site, at least one sample from each location should be collected. Samples from leachate seeps that are near each other can be composited if they:

are similarly colored
have similar liquid phases, and
appear similar when scanned with field instruments.

Samples from different sides of the landfill should not be composited.

Unlike groundwater and surface water sampling, leachate sampling should occur shortly after a precipitation event. Leachate would be expected to be flowing at its highest volumes at this time.

B. Parameters

When samples are collected as part of the ISA or CSA, they should be analyzed for the same parameters as groundwater samples. When the samples are part of a regular monitoring program, the required parameters will be established in the permit.

C. Schedule

A sampling schedule of the primary leachate collection system at lined facilities will be established in the permit issued by the Division of Solid Waste Management. The collection of leachate seep samples would most likely occur during the ISA and CSA and the need for further periodic sampling would be determined by the Department. Leachate sampling is also required for the issuance of a groundwater discharge permit or sewer connection permit.

D. Reporting

The results of both leachate seep and/or leachate collection system sampling and analysis should be submitted with the groundwater/surface water results. Specific requirements for what should be contained in the leachate sampling submittal package are the same as surface water sampling results.

IV. MONITORING OF THE SECONDARY LEACHATE COLLECTION OR LEAK DETECTION SYSTEM

When a landfill is designed with a secondary leachate collection system or leak detection layer the Department shall require monitoring of that layer. The owner/operator shall report the volume of leachate collected from the secondary leachate collection system for the given period as defined by the regulations or by the landfill permit. Leakage rates shall be reported to the Department for each inspection period as part of the inspection report. The owner/operator shall determine the rate of leakage per acre per day and compare the latest data with the designed leakage rate, the historical leakage rate and relevant meteorological data. If there is a significant increase in the rate of leakage the owner/operator shall identify the responsible area. 19.132(2)

V. LANDFILL GAS MONITORING

A. Monitoring System

Landfill gas monitoring requirements are more site specific than groundwater and surface water monitoring. Section 19.132 (4) requires that landfills conduct gas monitoring during their active and post-closure period. The Department may use its discretion in allowing some operating landfills to postpone their landfill gas monitoring program based on site specific conditions. Particularly:

> The proximity of the landfill to nearby buildings, are no nearby receptors at risk.
>
> Landfill size, larger landfills are naturally going to produce larger volumes of gas which may result in odor and potential migration problems.
>
> Other site specific criteria.

Operating landfills that pose a potential threat are required to install gas monitoring wells around the perimeter of the site, away from the active face, to protect them from damage. They should be more concentrated in the area between the landfill and potential receptors of the landfill gas.

Closed and closing landfills are required to install landfill gas vent systems, and landfill gas monitoring wells around the site. The monitoring wells are installed to determine the effectiveness of the venting system and act as an early warning system in the event of lateral migration. As with groundwater monitoring wells, the number required to properly monitor the site will vary. The owner/operator must be able to demonstrate that the system they propose will be capable of detecting any landfill gas that may be leaving the site.

As with the groundwater monitoring wells, it is important to know as much as possible about the geology of the site prior to landfill gas monitoring well installation. Gas tends to follow the path of least resistance, so determination of the presence, location and orientation of any more permeable geologic strata is an integral part of the gas monitoring system design. The location of any anthropogenic features that may affect the flow of landfill gas should also be considered during the design phase, i.e. bedding around sewer, electric, and telephone lines. Groundwater elevation is also an important factor when designing the vent and monitoring system. Gas flows along its own pressure gradient and can migrates in a direction opposite groundwater.

B. Parameters

Once the wells are installed the volume and composition of the gas generated and released from the site must be determined. A landfill gas monitoring proposal capable of achieving these goals must be submitted to the Department for review and approval prior to its implementation. Section 19.132(4)(f) requires the gas be sampled for the level of hydrogen sulfide, volatile organic compounds and combustible gas present as a minimum. The Department has the discretion to require more sampling and/or locations when appropriate.

VI. ANNUAL REPORT

Upon completion of each year of monitoring, an annual report shall be submitted to the Department. The purpose of the report is to summarize the results of the environmental monitoring program for the proceeding year, compare the results with previous years, and make recommendations accordingly. The report should provide a comprehensive interpretation of the whole sampling program. Any recommendations to either augment or reduce the monitoring program must be supported by data.

This report must contain the data generated during the quarterly or semi-annual sampling events, but discuss in more detail the contaminant profile, historical trends or unusual events associated with the data and the interrelationship between the sampling result from the various media in the monitoring program. This discussion should address potential impacts associated with these compounds, their potential impact on sensitive receptors identified in the CSA and recommended remedial actions where necessary. Any remedial actions taken in response to monitoring results should be discussed in detail.

CHAPTER 5 LANDFILL ASSESSMENTS

I. INTRODUCTION

The recently promulgated solid waste regulations update the limited environmental monitoring and assessment requirements contained in the 1971 regulations. The new regulations require more extensive monitoring requirements; more media must be sampled and more comprehensive analysis of the samples that are collected must be performed. But more importantly, the regulations also contain various trigger mechanisms that require a comprehensive environmental assessment of the landfill. An assessment is required pursuant to the following conditions.

- When obtaining Site Assignment.

- When obtaining a permit for an expansion of an existing landfill.

- When monitoring results indicate contaminants are at unacceptable levels. For example, when:

  Groundwater monitoring results indicate contaminants are above the MCL or the Department has determined that levels warrant an assessment and corrective action. [19.132 (1)(j)]

  Surface water monitoring results indicate contaminant levels are above background. [19.132 (1)(i)]

  Leachate monitoring levels indicate that leachate is present in the secondary containment system or leak detection system in excess of design standards. [19.132(2)]

  When gas monitoring results indicate that 25 % of the LEL is exceeded beyond the site boundary or in any on-site structure. [19.132(4)(g) 2.]

- When preparing the landfill for closure. [19.140(3)]

The purpose of the assessment is to determine the impact of the landfill on groundwater, surface water, and air quality by qualitatively and quantitatively characterizing the nature and extent of the contamination and assessing the associated risks to public health and the environment.

In general, the assessment process involves compiling a site history, characterizing the subsurface, determining potential rates and pathways of contaminant migration, identifying potential sensitive receptors, and determining existing air, ground and surface water quality. The reach of an investigation depends greatly upon site specific geologic conditions, the size of the site and the site history. Specifically, the Initial Solid Waste Site Assessment (ISA) consists of a historical and literature review, an evaluation of existing data and the identification of sensitive receptors. The information gathered during this phase will be used to develop the monitoring network that is part of the next phase, the Comprehensive Site Assessment (CSA). The Comprehensive Site Assessment (CSA) is comprised of field investigations and report preparation.

The DEP has adopted a three phased approach for performing environmental assessments of solid waste disposal facilities to establish a process by which the site specific data necessary to fully characterize a site may be collected, analyzed and presented in a routine and organized manner. The process is intended to minimize duplicative work, expedite reviews, establish and maintain complete site histories and achieve regulatory compliance with all relevant DEP programs.

Each phase builds on the data gathered in the previous phase. In all cases, the assessment will follow the same general outline, whether the assessment is for site assignment or closure purposes, beginning with research into the site's history and hydrogeological setting. However the difference will be in the goal of each phase. The goal of an assessment of an existing facility is to determine the extent of environmental impact caused by the landfill. For siting purposes, an assessment characterizes the site hydrogeologically and identify potential future pathways of contaminant migration to determine if the site is appropriate and if so, properly design the monitoring system for the site. Performing assessments prior to landfill construction will provide good data on background environmental quality, and provide up-front identification of potential contaminant pathways and receptors. This information will enable the Department to evaluate the performance of the groundwater protection system through the life of the facility.

The Landfill Assessment and Cleanup Program of the Division of Solid Waste Management offers an outline for scopes of work for the Initial Site Assessment (ISA) and Comprehensive Site Assessment (CSA) entitled "OUTLINE FOR SOLID WASTE SITE ASSESSMENT". This document, available from the Division, should be used as guidance when a proponent is developing an assessment scope of work.

The third step to the process, the Closure Alternatives Analysis (CAA) involves identifying several closure technologies, evaluating them for their environmental benefit and economic impact, then choosing the appropriate closure method. The guidance for this phase of the process is still in the developmental stage. Limited information is provided herein, however further information will be forthcoming.

The purpose of this chapter is to further supplement the outline and provide a comprehensive source of information to towns and cities who are conducting assessments of their landfill. If, however, during the course of the assessment, there are any questions regarding the assessment the Department is available for assistance.

Communities are encouraged, as a cost saving measure, to conduct much of the work themselves. Many of the tasks in the ISA can be performed by town employees, who would most likely be the information source for consultants hired by a town. Some of the CSA tasks can also be performed internally. As the work becomes more specialized, environmental consultants will have to be hired. However, it is still helpful and cost effective for municipal employees to work with the consultant in performing some of the less specialized tasks, i.e. surveying property boundaries, measuring water elevations and reviewing files.

The assessment process, outlined below, represents the universe of possible assessment work which may be undertaken at a facility. It is not anticipated that the entire list of activities will be required for each landfill assessment. For a number of existing facilities there may already exist a substantial compilation of site specific data and a moderately high level of understanding of the site. However, many existing facilities have undergone no prior assessment. For such facilities the scope of the site investigation will be more comprehensive. It is the intention of the Department that all facilities address all tasks listed in the guidance during the course of an assessment. DEP's primary goal is to obtain an adequate and equal level of information concerning new, active, and closed facilities within the Commonwealth.

II. INITIAL SITE ASSESSMENT (ISA)

An ISA is the first component of a site assessment to be performed pursuant to the LAC. The primary activities during the ISA are to gather and evaluate all existing information relating to the landfill site, develop a conceptual model of the site, identify potential receptors surrounding the site and plan and organize the Comprehensive Site Assessment (CSA) that will follow. The goals of the ISA are to identify all areas that must be investigated, minimize duplicative work, and maximize the quality of data generated during the CSA.

The ISA consists of five main components:

- Collection and evaluation of all available site data such as historical information and existing technical reports and/or plans in conjunction with a site visit;
- Definition of site conditions, as they pertain to geology and Hydrology, and the potential presence of contaminants;
- Identification and mapping of potential environmental and public health receptors that may be sensitive to contaminant releases;
- Definition of activities to be performed during the CSA and;
- Development of a detailed scope of work for activities to be performed during the CSA.

Once the information has been gathered, it should be summarized following the format of the Department's above referenced guidance outline. The ISA report will conclude with a recommended scope of work for the CSA based on the results of the ISA report. It should closely follow the scope that is outlined in the guidance and detail the rationale used in its preparation. Specifically, rationale used in determining: groundwater monitoring well depth and placement, environmental sampling locations, the inclusion/exclusion of optional analytical parameters and other tasks in the guidance outline, should be included in the scope of work report.

The following outline explains in more detail the purpose of each portion of the ISA and indicates potential sources of information that can be helpful when preparing the assessment scopes and reports.

A. TASK 1.1 BACKGROUND INFORMATION

The purpose of this task is to identify ownership, size and location of the site and abutting property land uses. Site ownership should be traced back to the time the site was first developed. It is possible for adjacent properties, or historical operations to be responsible for contaminants detected in the landfill monitoring system. Background information on adjacent land uses, present and past operations and materials used and generated, along with other hydrogeologic information, can help determine if the landfill is the source of contaminants found in the monitoring system. The assessors' officer in the town where the site is located will supply most of the required information.

B. TASK 1.2 HISTORICAL RESEARCH/TASK 1.3 LITERATURE/DATA SEARCH

Background information will be collected and used to develop the sampling and analytical plan for the CSA, and to help interpret the data generated. The goal of both these tasks is to focus the CSA and reduce the potential for duplication of effort by gathering, compiling, evaluating all existing information that relates to the site and local area. This can be achieved through several means.

The operational and disposal history may provide information on waste-types received and specific areas where they may have been disposed on-site. If disposal records aren't available, which is usually the case, a good source of this type of information are the past and present landfill operators. To find out past and present industries in the town, either the Town assessors office or the Sanborn Fire insurance library can be very useful. The Sanborn Fire Insurance library is located on the second floor at 156 State Street, Boston. They have historical maps depicting industries present in most Massachusetts towns. A preliminary assessment form should be used to summarize the historical data. These forms can be found in the Massachusetts Contingency Plan, or may be obtained from DEP's Division of Solid Waste Management.

Information gathered during a literature search will be used to complete other tasks in the ISA. This would include past and present information on operating procedures, wastes disposed, local industries (to help characterize the waste stream), and local and regional geology, hydrology, water supplies, as well as any existing environmental monitoring reports on nearby sites or the landfill itself.

An evaluation of the accuracy and usefulness of the data collected is an important part of the ISA. In addition, a list of reports and files reviewed and people interviewed should be compiled. Reasons for including or excluding information should be provided in the report.

In addition to evaluating existing reports, an evaluation of existing monitoring systems, monitoring programs and the data they've generated must be performed to validate the decisions to expand/reduce monitoring that will be part of the CSA. This evaluation should address whether appropriate analytical parameters were part of the program and whether appropriate procedures were followed. If an evaluation of the existing reports and environmental monitoring system reveals the work was done properly and the system is still intact, the proposed CSA scope of work should incorporate and reflect the information.

C. TASK 1.4 HYDROGEOLOGICAL DESCRIPTION

Regional and local hydrology and geology should be described and illustrated to the extent possible using available data. The intent is to gather sufficient information to determine appropriate locations for proposed borings under the CSA.

Depending on the location of the subject site, sources for this type of information include:

- local university geology theses;
- U.S Geological Survey papers and maps; and
- DEP files, particularly "21E" files.

Many environmental reports have been generated pursuant to MGL Chapter 21E, DEP's "hazardous waste cleanup" program, and they can provide a good source of information. A report prepared for any site in the community is likely to contain such relevant information as regional and sometimes local geology/hydrology and background groundwater quality. These reports are public information once they are submitted to the DEP office. Sometimes a 21E report is prepared and not submitted to the DEP. A Town may be able to access the report from the property owner or potential buyer.

D. TASK 1.5 SITE VISIT

A site visit must be made to confirm the site location and evaluate site conditions. While on-site, the following information should be gathered:

- Evidence of environmental impact,
- Evidence the area is used for unofficial recreation (dirt bike tracks, empty beer cans, etc.), indicating that there is an unexpected group of potential receptors that must be addressed,
- Location relative to potential receptors (nearby homes, schools, day care centers, elderly housing, water supplies, farms, wetlands, streams, rivers, etc.)
- Direct information on the site geology/hydrology;
- Status of existing monitoring wells and a determination on their integrity,
- Unforeseen site specific restrictions on potential monitoring well locations. Often well locations are determined based on information contained on a simple site map. These often do not indicate locations of trees, steepness of slope, utility lines, or other features that would make well installation difficult. These problems are more efficiently handled during the design phase, with all the site information is gathered and reviewed before scheduling the drill rig.

All observations should be summarized and presented on an appropriately scaled plan. The guidance scope of work contains a more detailed checklist that can be used as an outline for site visit objectives.

E. TASK 1.6 MAPPING

An up to date site and regional map must be prepared during the ISA. The information listed in the guidance scope outline must be addressed at a minimum, as well as any other available information deemed relevant, to assist in development of the CSA scope of work. The site map should be as detailed as possible. Detailed identification of existing structures, water supplies, water bodies, and recreational areas will help to ensure that any potential threat posed by the landfill will be considered when scoping out the CSA.

The Mass Geographic Information System (GIS), at the Department of the Executive Office of Environmental Affairs manages a computer data-base of land-use information which can be used to readily produce customized maps. Mass GIS has compiled all of the data needed to produce the locus map required under Section 1.6 B of the assessment guidelines. Information on local land-use, zoning and other potential sources of contamination is also available.

Because the maps are computer generated, all of the information can be plotted on one sheet, regardless of the number of U.S. Geologic Survey quadrangle maps that are required to address a half-mile radius around the site. Since Mass GIS is part of a State Agency, the information is public, and the cost for map production is minimal. It is recommended that the locus maps required under the assessment guidelines be produced by Mass GIS simply for convenience. However, GIS maps are not required. Information on obtaining GIS maps from the Department is given in Appendix H.

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F. TASK 1.7 FIELD SCREENING (OPTIONAL)

Environmental sampling or field screening can be done as part of the ISA and can be useful when characterizing qualitative contaminant levels or localized areas of contamination. The detection limits of screening instruments used to evaluate the presence of contaminants are not usually very low, so they are not useful in determining if an area or media are contaminant free. They can, however, be used to obtain data on relative concentrations of contaminants present.

Flame ionization detectors (FID) and photoionization detectors (PID) are often used in the field to screen for the presence of contaminants in soil. Generally, these instruments are used to screen the headspace above soil in a closed container. The soil is placed in the container, agitated, and then allowed to equilibrate. After a short time has passed, five to ten minutes, a probe from the instrument is placed in the jar and a reading is taken. These instruments are sometimes used to measure the ambient air for contaminants. For more specific information on this field procedure or how to use the instrument, please reference DEP's standard references, and manufacturer's instructions.

A limited number of samples may be collected for laboratory analysis. Samples are usually collected when there are areas of known contamination or if there is a monitoring system in place that can be accessed. The data can then be used to prepare the sampling and analytical program for the CSA.

Non-invasive techniques, such as geophysics, can be used to characterize the subsurface. Features such as top of bedrock, the water table, buried objects and sometimes relative permeability can be determined with geophysics.

G. TASK 1.8 DEVELOPMENT OF CSA SCOPE OF WORK

The final stage of the ISA is the preparation of the CSA scope of work. The scope should be based on the guidance provided by the Department and be able to:

- determine if the landfill has had any negative impact on the local environment,
- determine the need for remediation of the landfill site, and
- identify and characterize the extent of any impact which may be present.

Requirements for the CSA scope of work are discussed in more detail in the next section of the guidance.

III. COMPREHENSIVE SITE ASSESSMENT (CSA)

In the CSA, the data necessary to characterize the site's subsurface and evaluate environmental impact or potential impact are collected, recorded and analyzed. It is important that all activities, observations, computations and conclusions are recorded in a logical manner, in order to create a document practical for public review. The CSA consists of the following subsections: site mapping, drilling program, sampling and analysis program, health and safety plan, and data compilation/report preparation.

A. TASK 2.1 ISA SUMMARY

Conclusions drawn and recommendations made in the ISA should be summarized and any important facts or insight relating to the site should be highlighted.

B. TASK 2.2 MAPPING

Mapping that takes place during CSA is limited to updates to the existing base map (new sampling locations for example) or addition of site topography. All other mapping activities should have occurred during TASK 1.6 of the ISA.

C. TASK 2.3 DRILLING PROGRAM

It is very important to spend extra time when developing a drilling program. When properly executed, the most valuable information with respect to site characterization is collected during this task. Split spoon samples and bedrock cores are retrieved, monitoring wells and piezometers are installed, samples are taken and direct measurements of the subsurface can be made. As drilling can be one of the most costly parts of an assessment, it should be done efficiently. Careful consideration should go into choosing well locations, monitoring well construction materials and methods. Monitoring wells must be installed and constructed according to standard, accepted methods. Documentation is of the utmost importance. The rationale used to develop the proposed well and sampling locations must be incorporated into the scope of work. Providing this information will allow the Department to properly evaluate the scope of work, and will reduce the review period. Improperly placed, or constructed monitoring wells do not provide useful information and may provide a direct conduit for contaminants to enter the subsurface. Any wells the Department deems unacceptable will have to be properly abandoned (removed and closed) and replaced.

Excellent sources of guidance on how to site, and construct a monitoring well include EPA's Technical Enforcement Guidance Document (TEGD) and the book Groundwater and Wells published by DRISCOLL. The Department has just released the Groundwater Well Standard References which provide detailed guidance on every aspect of field procedures performed as part of an assessment. The Standard References are available for approximately 39.00 from the State House Bookstore.

D. TASK 2.4 DETERMINATION OF HYDRAULIC CONDUCTIVITY

Information gathered during this task will be used to evaluate the relative rate at which groundwater flows and contaminants may migrate once they enter the groundwater. A low hydraulic conductivity indicates the soil is tight and or the groundwater table is relatively flat, so that groundwater flow is relatively slow through the material. A high value would indicate that the rate of groundwater flow is more rapid. Hydraulic conductivity also yields information on potential relative dispersion rates; high flow rate usually corresponds to a higher rate of contaminant dispersion.

This information will also be used to design the groundwater monitoring system. Therefore, in addition to simply determining the hydraulic conductivity, an effort should be made to identify and note the location(s) of high permeability layers encountered during well installation, test pit excavation, or in outcrops observed in the field. Contaminants tend to migrate towards and then through zones with high hydraulic conductivity. Monitoring wells should be installed and screened in these zones to increase the probability of encountering contaminant plumes if they exist.

Reference to the method or methods that will be used to collect and analyze the data should be described in the scope of work. Hydraulic conductivity tests can be run either during or after well installation. Commonly, tests are run after the well is installed and developed. Generally one of the following methods is used:

- slug/falling/rising head test;
- pump test.

The final report should include all raw data and calculations performed to determine the hydraulic conductivities reported.

E. TASK 2.5 SAMPLING AND ANALYSIS PLAN

Sampling and analytical methods performed under the CSA must follow standard accepted procedures. The methods chosen and reasons for doing so must be described in the CSA scope of work. The following guidelines should be observed:

- All sampling must be performed according to standard EPA, American Standard Test Methods ASTM or DEP protocol. (As mentioned previously, DEP's Standard References is available at the Statehouse bookstore.) In addition to the proposed sampling technique(s), proper QA/QC of field activities must be documented in the scope of work and implemented in the field.

- Groundwater sampling should begin with the least contaminated wells and end with the most contaminated wells where possible.

- Groundwater samples should be collected immediately after the well is purged. If the well has been bailed dry and is slow to recover, samples should be collected in order of decreasing volatility as soon as there is enough water in the well to satisfy the sample volume requirements.

- Appropriate sampling equipment must be used. It is not appropriate to use equipment that may strip volatiles from the water (peristaltic pump) or needlessly agitate the sample (bailer in excess of 1.5 feet in length) when collecting samples.

- Surface water and groundwater samples collected from different locations cannot be combined. At a minimum, this practice results in possible dilution of contaminant concentrations, unnecessary mixing and agitation resulting in volatilization of contaminants from the sample, and the need for additional sample collection to determine which sample is responsible for elevated levels detected. The Department will not accept samples collected in this manner.

- Soil samples may be composited. However the rationale behind doing so, and confirmation that the samples are biased to ensure that any contamination present is not being diluted, must be presented in the scope of work.

- All samples must be properly preserved and the preservation method used must be referenced in the scope of work.

- Water samples must be collected directly into their respective sample bottles. The practice of collecting water into a large container then pouring off the water into sample bottles for shipment is not acceptable. This method results in unnecessary disturbance of the sample.

- All samples must be collected on the same day unless circumstances, which are clearly discussed in the scope of work or report, require otherwise. *Landfill gas samples are exempt from this requirement.

- Landfill gas must be sampled and analyzed during both winter and summer seasons at a minimum, in addition to quarterly monitoring for combustible gas levels. This will allow for comparison between the two seasons and a general determination of the effect of frost on gas migration.

- Samples must be analyzed within proper holding times by a State certified lab.

- The sample collection method that should be followed when sampling a leachate seep is:

  Locate the seep(s) to be sampled;

  Dig several inches into the origin of the seep with a shovel, creating a small collection area;

  As the leachate begins to flow from its origin,place the sample container against the side slope and collect the sample directly with sample containers. Particularly when sampling for VOC's, try to limit the sample exposure time and agitation to the sample to reduce the loss of the loss of volatiles and chemical alteration of the sample from exposure to oxygen.

There are minimum requirements that these procedures must meet for the submitted data to be valid. Please reference the Department's Standard references for more detailed information.

The guidance outline has detailed a recommended analytical plan that should be used as reference when developing the CSA scope of work. The parameters proposed in the CSA scope, as well as their respective analytical method numbers, must be included in the scope of work. The rationale for the inclusion/exclusion of parameters listed in the scope of work guidance must be documented in the proposed scope of work. For example, historical information which revealed that a pesticide manufacturing plant had operated in town would indicate the need for extensive analysis for the presence of pesticides at and around the site. Prior sampling and analytical results may also be the basis for recommending other specific analyses. Conversely, if there is no information on historical disposal practices, an initial screening for all types of contaminants at key locations during the initial phase of the CSA may be necessary. These issues must be addressed in the sampling and analysis portion of the CSA scope of work.

Any variance from standard procedure should be justified in the scope. If unanticipated field conditions dictate that innovative sampling methods must be used at the site, the methods followed and the reasons for deviating from the scope of work should be described in the final report.

F. LANDFILL GAS

There are several methods and instruments that are used in the field to determine the composition of landfill gas. The instruments include:

photo ionization meter - qualitatively measure the non-methane components.

Explosimeter- qualitatively measure gross levels of explosive gas present in a well or in ambient air.

Organic Vapor Analyzer - (flame ionization detector) qualitatively measure methane and other gaseous compounds when lower concentrations are present.

Field GC - (flame ionization detector) quantitatively evaluate gas by breaking down the gas into its individual components. When standards are available, the compounds can be identified and quantified.

Draegar Tubes - qualitatively/quantify the level of a specific constituent. They provide a rough estimate of the actual concentration and are only useful once the levels reach the part per million range. They can be used to measure many components, however they are most useful at landfills when measuring hydrogen sulfide.

Laboratory methods to determine landfill gas composition are also used. These include the collection of gas in tedlar bags, or adsorption of compounds onto tennax tubes in the field, and then purging the compounds in a laboratory for identification by gas chromatography.

Landfill gas migration poses the most direct threat to public health and safety, therefore every effort should be made to ensure the landfill gas is properly controlled. Landfill gas generation and migration is quite variable over time. As such, it is difficult to characterize site conditions as they relate to gas generation and migration without establishing a significant database. At present, there is not a lot of information available on landfill gas characterization. As studies advance, DEP guidance and specific requirements will be refined. The following process, based on the information currently available, is suggested to develop a database upon which conclusions on gas constituents, generation rates and potential for off-site migration can be drawn. The Department is open to alternative methods and constructive criticism to better refine the process.

1. RECOMMENDED LANDFILL GAS MONITORING PROCEDURE

1. Collect frequent readings of % levels of explosive gas present at the monitoring wells. If possible, daily readings over the course of a month, progressing to weekly, bi-weekly, etc. until a complete picture of the situation is obtained. An explosimeter is used to collect this information. The town fire department likely has one of these instruments. If not, they can be purchased for approximately 350.00 and are simple to operate, anyone in town could use them. Any on-site buildings or potential conduits of the gas, i.e. utility lines, man holes should also be monitored.

2. Plot the sampling locations and the concentrations obtained, looking to identify any potential trends.

3. At least two sampling events should be conducted to characterize the individual components in the landfill gas. These events should occur once in the winter, and once in the summer. The need for additional/more frequent laboratory analysis will depend on the constituents found, their concentrations and relative proximity to potential receptors.

4. An effort to evaluate the volume of gas being generated must

also be made. There are flow meters available that can be placed on a well that will measure flow from the well continuously.

5. Over time, all the data collected during the tasks identified above should be organized and evaluated. A determination on the quality and quantity of gas expected from the site with recommendations for vent design should be made.

Generally, the above tasks would be required for inactive/capped landfills. However, if off-gassing and venting was shown not to be adequate to prevent lateral migration at an operating landfill, determination of landfill gas generation volumes and rates would be required. The information obtained would be used to design a venting system and if necessary, an active collection system.

G. TASK 2.6 HEALTH AND SAFETY PLAN

Before any field work begins, a suitable health and safety plan must be prepared. The plan must establish the level of personnel protection appropriate for the site with provisions for an upgrade and site conditions under which the upgrade would be required. A health and safety officer must be identified and must be present on-site when field activities/conditions result in an increased risk. Many health and safety plans require that a health and safety officer be present when site conditions warrant level B protection and above; they may also be present when workers are in Level C. In addition, the plan must provide emergency telephone numbers, identify the nearest locations and routes to emergency facilities, establish on site decontamination areas and personnel decontamination procedures.

H. TASK 2.7 PROJECT SCHEDULE

The schedule should indicate estimated start and completion dates for each individual task. The schedule should be realistic.

I. TASK 2.8 DRAFT CSA REPORT SUBMITTAL

This section of the guidance outline is fairly straightforward. Each of the items listed should be addressed in the final CSA report.

1. Data Interpretations and Presentations

This section should evaluate and interpret the site environmental data with respect to background and make conclusions regarding the landfill's impact on the local environment. The local hydrogeology should be characterized; groundwater flow rate and direction determined; all potential contaminant migration paths identified; and groundwater and surface water quality, both upgradient and downgradient, should be defined. Any potential risks to or impacts on human health or the environment should be identified. It is possible the data indicates that there has been little/no negative impact from the landfill. All conclusions and recommendations in the final report must be clearly supported by the data.

When an assessment is performed on an undeveloped site, it should focus on the characterization of local hydrogeology, particularly definition of background conditions, groundwater flow direction and rate, and identification of potential contaminant pathways. The information will be used to develop the monitoring system for the new facility.

2. Maps Plans and Figures

All maps, plans and figures listed in the guidance outline should be prepared, compiled and submitted as part of the assessment report. The geologic map and piezometric flow maps should be interpreted and discussed in the text of the report as mentioned above in section A). Sampling and analytical results should identify the location of contaminant plumes by referencing the site map and specific sample locations. Indicating the location of contaminant plumes, hot spots and their concentrations directly on a site map will be useful, particularly for when preparing the risk assessment portion of the report.

3. Summary Tables and Forms

All materials listed in the guidance outline should be prepared and included in the report. Well schematics and boring logs should be submitted as an appendix. Data tables should be inserted into the text where relevant.

4. Baseline Qualitative Risk Assessment

A baseline risk assessment, which identifies and evaluates potential health risks resulting from the landfill, is required only for existing facilities.

First, all potential receptors must be identified. Drinking water supplies, both private and public, are the first concern. Recreation areas, residences, schools, surface waters etc. should be included in the list of potential sensitive receptors.

Next, all contaminants, their maximum concentrations and where those levels were detected should be either listed or displayed on a site map. It is probably easier to work from a site map. The media sampled should also be noted (surface water, soil, sediment etc.).

Then, a qualitative evaluation of the potential for the contaminants to reach the listed sensitive receptors should be conducted and then described in the text.

The secondary purpose of the risk assessment is to identify all non-health risks or impacts on local environments. All leachate breakouts and local groundwater discharge areas must be identified. And as above, a qualitative determination of the impact the landfill and associated contaminants have on the environment must be made.

This process is considered preliminary, but may be sufficient depending upon the data, methods used in its interpretation and outcome. The result of the qualitative risk assessment will be one of the following:

- existing data is sufficient to indicate that there is no significant threat from the landfill;
- existing data is not sufficient to base a decision on the level of risk posed by the landfill, additional assessment work is necessary; or,
- existing data indicates there may be a significant risk to public health or the environment, therefore a more detailed qualitative risk assessment is necessary and or remedial measures are necessary.

The recommendation to perform a detailed risk assessment must be discussed with the appropriate the DEP site manager prior to its commencement. This decision may be made either prior to submittal or after submittal and review of the draft CSA report. The final determination on the adequacy of the qualitative risk assessment will be made by the Department.

All conclusions must be backed by data generated during the Comprehensive Site Assessment. The decision to require remedial measures such as groundwater collection and treatment will be based on the results of the risk assessment. The risk assessment will also be used to determine if the site qualifies for an alternative closure design, described in the following section.

IV. CLOSURE ALTERNATIVES ANALYSIS (CAA)

A. PURPOSE

The Closure Alternatives Analysis (CAA) step of the assessment provides the landfill owner with an opportunity to evaluate a number of options for securing the landfill in addition to the traditional closure described in Chapters One and Six. In some cases the CAA will aid in selection and design of additional closure measures necessary to abate significant environmental and public health risks. In other cases, the CAA will aid in the selection and design of technologies which can make up a lower cost alternative to the standard closure while still protecting the public health.

B. WHEN ALTERNATIVE CLOSURE IS APPROPRIATE

Alternative Closures are appropriate in a number of cases. They must be considered when public health or environmental risks from the landfill cannot be fully addressed by traditional closure. Specifically, alternative closures are called for when:

- private or public drinking water supplies are contaminated;
- high levels of landfill gas emissions are present which present a danger of explosion or a health concern due to exposure;
- shellfish beds or wetlands are contaminated.

Alternative closures should also be considered when a traditional closure is overly protective and costly to implement. Specifically, an alternative closure should be considered when:

- a comprehensive assessment indicates that littlE contamination is emanating from the landfill; AND
- no public health or environmental receptors exist which may be effected by the landfill.

C. DEVELOPMENT OF CLOSURE ALTERNATIVES

Closure alternatives options are developed in a three-step process:

1. Listing of appropriate technologies
2. Screening of technologies
3. Integration of screened technologies into closure alternative option "packages"

First, a list of potential technologies which are applicable to the site-specific conditions at the landfill is completed. This list should comprise all technologies which may be appropriate to address existing contamination. Technologies relevant to each effected environmental media at the site (air, groundwater, leachate, surface water, wetlands, soils) must be listed.

1. Applicable Technologies

For each environmental media which is contaminated, there are a number of basic technology types which are applicable. The following summary (organized by media) should be used only as a starting point when developing a comprehensive list of applicable technologies. Following this summary, subsurface drains and subsurface barriers are discussed in detail as they are the most commonly used corrective actions for landfill site remediation.

- Leachate
    - collection systems
        - subsurface drains
        - vertical extraction wells

    - treatment systems
        - biological
        - physical
        - chemical

- Groundwater
    - barriers to migration (slurry wall)
    - alternative water supply
    - wellhead treatment
    - groundwater recovery (pump and treat)

- Air (landfill gas)
    - passive systems
        - venting pipes
        - perimeter trench
    - active systems
        - collection wells with flaring
        - collection wells with energy recovery

- Surface Water **
    - air stripping
    - neutralization
    - metals precipitation
    - biological treatment

- Wetlands **
    - biological, chemical treatment of sediment
    - dredging
    - restoration

- Soils **
    - hot spot excavation and treatment
    - vapor extraction

** NOTE: It is not expected that this type of technology will often be applicable to closures of municipal solid waste landfills, due to the generally lower levels of contamination present and the extreme costliness of their use.

Subsurface Drains

Description:
Subsurface drains are used to convey and collect ground water by gravity flow. Subsurface drains create a continuous zone of influence in which ground water within this zone flows toward the drain.

Applications / Limitations:
Subsurface drains can be used to contain or remove a plume of leachate contaminated ground water, or to lower the ground water table to prevent contact of water with waste material.

The most widespread use of subsurface drains is to intercept a plume of contaminated ground water which is hydraulically down gradient from its source. Frequently, these interceptor drains, as they are commonly called, are used together with a barrier wall. There are two primary reasons for the interceptor drain/subsurface barrier wall combination.

In the case where a subsurface drain is to be placed upgradient of a stream, the drainage system would reverse the flow direction of the stream and cause a prohibitively large volume of clear water to be collected. The wall would prevent infiltration of clean water to be collected. The wall would prevent infiltration of clean water from the stream, hence, reducing the volume of contaminated ground water and associated treatment costs.

In another application, where the primary remedial action involves installation of a down gradient barrier wall to contain wastes, an interceptor drain can be installed just upgradient of the subsurface barrier wall to prevent overtopping and to minimize contact with wastes which may degrade the wall.

Subsurface drains may be preferred over pumping of ground water in instances where ground water removal is required over a period of several years, because the operation and maintenance costs associated with pumping are substantially higher. However, one of the biggest drawbacks to the use of subsurface drains is that they are generally limited to shallow depths.

Subsurface Barrier

The term subsurface barrier refers to a variety of methods whereby a low permeability cut-off wall or diversion is installed below ground water flow in the vicinity of a site. The most commonly used subsurface barrier is slurry-wall.

Slurry Walls:

Slurry walls are a relatively inexpensive means of significantly reducing ground water flow in unconsolidated earth materials. The term slurry wall can be used to describe a variety of barriers all having one thing in common: they are all constructed in a vertical trench that is excavated under a slurry. This slurry, usually a mixture of bentonite and water, acts essentially like a drilling fluid. It forms a filter cake on the trench walls to prevent high fluid losses into the surrounding ground. Slurry wall types are differentiated by the materials used to backfill the slurry trench.

Soil-Bentonite Slurry Walls:

Soil-bentonite slurry walls are backfilled with soil materials mixed with a bentonite and water slurry and are usually excavated into a low permeability confining layer such as a clay deposit or competent bedrock. This confining layer will form the bottom of the contained site. Hanging slurry walls are not tied into a confining layer but extend down several feet into the water table to act as a barrier to floating contaminants (such as oils and fuels) or migrating gases.

Circumferential installations are by far the most common and offer several advantages. This placement vastly reduces the amount of uncontaminated ground water entering the site from upgradient sources, thus reducing the volume of leachate generated. Also, provided there are no compatibility problems between site wastes and the wall materials, the amount of leachate leaving the down gradient side of the site will be greatly reduced. Moreover, when this configuration is used in conjunction with an infiltration barrier and a leachate collection system (or other means of reducing the hydraulic head on the interior of the wall), the hydraulic gradient can be maintained in an inward direction, thus preventing leachate escape.

A major consideration in the application of soil-bentonite walls to site remediation is the compatibility of the backfill mixture with site contaminants. Soil-bentonite backfills are not able to withstand attack by strong acids and bases, strong salt solutions, and some organic chemicals.

Operation, Maintenance and Monitoring:
As passive measures, slurry walls require no operation and little maintenance. Maintenance of the desiccation cap atop the wall is the only requirement that is specific to the wall itself. Maintenance of ancillary measures such as caps and leachate collection systems is important to the wall as part of the entire remedy. Monitoring of slurry walls usually involves monitoring ground water levels inside and outside the wall to ensure that design head levels are not exceeded. Ground water quality monitoring can be used to determine the effectiveness of the entire remedial effort.

2. Screening of Technologies

Next, this list must be screened to determine which technologies are truly appropriate for the site. Two basic questions must be answered in screening technologies for their appropriateness:

- will the technology address the existing level and extent of contamination in the relevant media; and
- can the technology be combined effectively with other appropriate technologies without adverse effects.

3. Integration of Technologies

Finally, successfully screened technologies are integrated into closure alternative "packages" which will be weighed against each other in the subsequent closure alternatives analysis step. In addition to a "no action" package and a standard closure package (cover system with passive gas and passive leachate control systems as applicable) which are included for comparison purposes, a minimum of two alternatives must be developed. Each of these must be comprised successfully screened technologies which address each media of concern.

For example, an alternative package developed to address ground water contamination and excessive levels of landfill gas might include a standard closure, wellhead treatment for a contaminated public drinking water supply well and gas extraction wells with flares. Alternatively, the package might include a standard closure, a groundwater recovery system and gas extraction wells with flaring. A third package to be considered might include standard closure, wellhead treatment and gas extraction wells with gas recovery.

In summary, types of closure alternative packages include:

- No action;
- Standard Closure;
- Alternative Package 1: standard closure plus successfully screened technologies; and
- Alternative Package 2: standard closure plus successfully screened technologies.

These alternatives are compared against each other in the closure alternatives analysis step which is described below.

D. ANALYSIS OF CLOSURE ALTERNATIVES

1. Methodology

During the closure alternatives analysis step a number of criteria are applied to each alternative package to determine whether it should be recommended for site closure. A four step process is employed to judge the alternatives which have been developed.

In the first step, selection criteria (which will be discussed in detail below) are applied to each package. Some of the alternative packages may meet all of the criteria, others will meet few of them. The packages are then ranked according to their ability to meet these criteria. Next, cost effectiveness and community acceptance are considered as weighing factors.

For example, a package may rank high because it meets many of the criteria, but be prohibitively expensive, or be unlikely to be accepted by the community. After these factors are considered, one alternative is recommended for implementation. The Department of Environmental Protection will consider this recommendation and select the alternative to be implemented.

2. Selection Criteria

For each alternative package developed, a thorough analysis of its ability to satisfy the following criteria must be conducted:

- protectiveness
- ability to comply with state, federal, local laws
- effectiveness
- reduction of contaminant toxicity and volume
- implementability

A detailed discussion of each criterion follows.

a. Protectiveness

This criterion is used to evaluate the ability of an alternative to provide protection of the public health and the environment - to reduce the risk from exposure to existing contamination. This is the primary concern in rating an alternative. If an alternative can not provide adequate protection, it can not be recommended.

b. Compliance

Each alternative must be evaluated in terms of it ability to comply with all state and federal environmental laws and local zoning considerations. Any alternative that would not comply with these laws can not be recommended.

c. Effectiveness

The long-term and short-term effectiveness of each alternative must be evaluated. To conduct such an evaluation, the alternative's reliability (whether or not it can be adequately maintained and controlled), permanence (whether will provide a permanent solution to contamination problems which may persist), and its predicted useful life must be considered. In addition, the balance between any adverse and beneficial effects of the alternative must be evaluated. If the adverse effects of the alternative outweigh the beneficial effects, it should not be considered.

d. Reduction of Toxicity and Volume

This criterion may not be appropriate to many closure alternatives as it is used to evaluate the effectiveness of treatment technologies. For a treatment technology (such as groundwater pump and treat or hot spot excavation and removal) to be effective it must be able to diminish contamination to an acceptable level as well as minimize the amount of residuals which remain.

e. Implementability

A number of factors must be considered in evaluating the implementability of each closure alternative package. The technical feasibility (will it really work?) and actual availability of each technology must be considered. The performance of each technology must have been demonstrated in a similar application. The requirements for and availability of support services such as utilities must be considered. The time it would take to implement each technology must be taken into account. If construction and start up time is too lengthy as to not mesh with the overall closure project schedule, the alternative should not be considered to be implementable. The safety of the technology must be weighed. Finally, operation and maintenance requirements including monitoring of performance must be factored into an evaluation of each alternative's implementability.

Once each of these five selection criteria have been applied to each alternative, two weighing factors - cost and community acceptance must be considered. These final criteria should be used to eliminate alternatives which may otherwise have been acceptable but are not realistic due to financial and political constraints.

CHAPTER 6 FINAL CLOSURE AND POST-CLOSURE GUIDANCE

I. INTRODUCTION

As a landfill reaches final elevation it must undertake numerous final closure and post-closure activities. Final closure and post-closure activities involve assessment of environmental impacts, remediation of problems where they exist, final capping of all uncapped portions of the site, installation of gas venting or collection systems, maintenance of the site, and monitoring of surface water, ground water and landfill gas.

Following closure, landfills may be used for a variety of purposes including passive and active recreation. Post-closure uses, if any, should be considered and planned well in advance of closure to coordinate closure design with the proposed post-closure use of the site.

Closure and post-closure activities require expenditure of funds at a time when the landfill is no longer bringing in any revenue through tipping fees or for municipal facilities, is beyond the useful life of the facility and is not included in the waste disposal budget. Therefore, it is essential that closure and post-closure costs be determined as early in the life of the facility as possible (at the landfill design stage, if possible) to plan for those costs through the life of the facility by establishing tipping fees or budgets appropriately.

A. Regulatory Requirements for Closure

Landfill operators are required to notify the Department no later than six (6) months prior to the date the facility will stop accepting waste, for whatever reason [310 CMR 19.045]. When a facility stops accepting waste, or even prior to that time, the owner or operator must undertake a landfill assessment in order to determine and evaluate the nature and extent of any adverse impacts of the facility on the environment [310 CMR 19.140]. The assessment should be used to develop an appropriate final closure/post-closure plan.

Upon closure of the facility, notice that a landfill was operated on the site [S. 19.141] must be recorded in the registry of deeds or in the registry section of the land court for the district in which the landfill is located.

The post-closure period has been established as 30 years during which monitoring and maintenance activities must be carried out [310 CMR 19.142]. This period may be extended by the Department where necessary, or reduced where the owner demonstrates that a shorter period is sufficient to protect public health, safety and the environment. Factors which would bear consideration might include the type of solid waste disposed, the quality and quantity of leachate produced, monitoring results and the location of sensitive receptors relative to the site.

Post-closure uses of landfills are allowed under the regulations with prior written approval of the Department after review of post-closure use plans. Certain limitations on post-closure use are contained within the regulations at 310 CMR 19.143.

II. CLOSURE REQUIREMENTS

Closure activities will vary from one landfill to another depending on the status of the site. For example, where a landfill has not been completed in phases and no monitoring system is in place, significantly more work will be required to properly close the site than if each phase of a landfill had been capped in succession and a proper ground water monitoring system is in place.

A. Landfill Assessment

The first phase of landfill closure is assessment of the landfill. In general, a landfill assessment should be completed prior to submission of final closure/post-closure plans. Landfill assessments are discussed in detail in Chapter 5 of this document.

Ideally, landfill assessments will play a major role in defining the final design of a landfill closure. Where no assessment has been undertaken, a landfill will be required to close in accordance with the final cover requirements specified in the Part II regulations [19.112]. However, where an assessment has been accomplished in compliance with Department protocols, it may be used to demonstrate that an alternative final cover design is appropriate and will adequately protect public health, safety and the environment [19.113]. Further information and guidance regarding the use of landfill assessments to define closure design is presented in Chapter 5, which discusses Closure Alternatives Analysis.

B. Closure Plans

Upon completion of a landfill assessment, a final closure plan should be submitted to the Department for review and approval. Contents of a closure plan are detailed in section 19.104(6), with additional requirements specified at 19.140(4). In addition, the final closure plan must include a report containing the findings of the landfill assessment and a proposed schedule of remedial actions, if any.

Closure plans and activities should address the following:

- final cover design, including:
    - final grading of the landfill;
    - subgrade layer;
    - gas venting layer;
    - low permeability layer;
    - drainage layer;
    - filter layer;
    - vegetative support layer;
    - vegetative cover;
    - alternative final cover design or waiver request, if applicable;

- remedial actions for leachate control, gas control, run-on or run-off control;

- leachate collection systems;

- final landfill contours;

- landscaping plan;

- construction plans for any on-site structures;

- storm water controls;

- gas venting or gas collection and recovery systems; an evaluation to determine if methane gas from the landfill can be collected and utilized as a source of energy may be desired. If such a plan proves feasible, then a detailed plan for the collection and use of methane gas should be submitted to the Department for review and approval;

- should methane gas collection and utilization plan not prove to be feasible, or be delayed, then an alternative or interim plan for venting and controlling methane gas generated by the landfill should be submitted for approval by the Department;
- ground water, surface water and gas monitoring systems;
- site security;

C. Closure Guidance/Requirements

- Drainage Ditches:
    - Drainage ditches should be designed to prevent erosion of the channel.
    - Drainage ditches should be regraded to eliminate any standing water.
- Leachate Collection System:
    - Surface leachate breakouts must be systematically repaired before placement of final cover.
    - Existing manholes in and around the landfill must be raised so that routine inspections of the leachate collection system can be easily conducted.
    - A perimeter leachate collection system may be required to control leachate outbreaks. The necessity for such a system should be discussed within the framework of the landfill assessment.
- Gas Monitoring System:
    - Gas monitoring wells and/or a system of gas probes should be installed around the periphery of the landfill, upon Department approval of the design.
    - If gas appears in a monitoring well, a venting trench may need to be installed to protect abutters to the landfill.
- Filling Surface Cracks:
    - All cracks and eroded areas of the landfill need to be filled with suitable material prior to placement of the final cover.
    - The top portion of the landfill should be graded to a slope of not less than 2% nor greater than 5%.
    - Side slopes should not exceed a 3:1 slope (three (3) horizontal to one (1) vertical).
- Site Security:
    - Access to the landfill will need to be controlled through the use of fencing, gates, locks or other appropriate means.
- Compliance:
    - Inspection and verification of compliance with the approved

closure plans must be certified in writing by the consulting supervising engineer and approved by the Department. The certification must include as-built plans.

- No changes can be made in the approved closure plans without written approval from the Department.
- If, due to reports by the engineers and/or inspections by the Department, it is determined that the facility as designed, constructed, and closed does not adequately protect the public health and the environment, the Department will require the necessary remedial actions at that time.

III. POST-CLOSURE REQUIREMENTS

Following placement of the final cover monitoring and maintenance activities will need to be carried out for the specified post-closure period. This period is established as 30 years in the regulations, but may be extended should the Department determine that a longer period of maintenance and monitoring is required to adequately protect human health and the environment. Alternatively, the post-closure period may be shortened upon demonstration by the operator that the site will not pose a threat to public health, safety or the environment. Such a determination must, in part, be based upon valid monitoring data.

A. Post-Closure Plans

Post-Closure plans must be submitted at the same time as the closure plans. Requirements for post-closure plans are included at 19.104(6) and 19.140(4). Post-Closure Plans should address the following:

- leachate management plans;
- settlement of the landfill and settlement monitoring;
- general maintenance procedures and schedule, including:
    - inspection of the landfill surface for cracks, erosion, settlement and vegetative growth;
    - inspection and repair of drainage and run-on, run-off control structures;
    - monitoring systems;
    - leachate collection system inspection, flushing, and clean out, including the inspection and maintenance of all pumps;
    - repair and replacement of leachate collection lines and force mains;
    - site security;
- monitoring requirements and schedule;
- post-closure uses, if any.

B. Post-Closure Guidance

- Leachate Collection:
  - The collection and pumping of leachate must continue after closure for the entire post-closure period, or until it is demonstrated to the Department's satisfaction that the quality of the leachate will not pose a threat to ground or surface waters.
  - Leachate flow calculations should be continued throughout the post-closure period.
- Settlement Monitoring:
  - Settlement of the landfill should be monitored after closure so any low areas on the surface can be filled and approved grades maintained. At a minimum, this monitoring should be done on a quarterly basis.
  - If the slope of the top of the landfill decreases to less than a 2% grade due to settlement then additional cover material should be placed on the landfill to reestablish the approved slope.
- Groundwater, Surface Water and Gas Monitoring:
  - Ground water, surface water and gas monitoring must continue for the length of the post-closure period.
  - Sampling frequency and analysis parameters should be established in the closure plan.
  - Monitoring should be conducted according to the approved schedule.
  - Refer to Chapters 5 and 7 for additional guidance on groundwater and gas monitoring respectively.
- Repair of Erosion:
  - The repair of erosion gullies will require a commitment of resources for the entire post-closure period, but the occurrence of erosion gullies may be minimized by the establishment of good vegetative growth.
- Compliance
  - No changes can be made in the approved post-closure plans without written approval of the Department.
  - If, due to reports by the engineers and/or inspections by the Department, it is determined that the facility as designed, constructed, and closed does not adequately protect the public health and the environment, the Department will require the necessary remedial actions at that time.

IV. POST-CLOSURE USE

A. Introduction

It may be possible to use landfill sites for other purposes after closure of the facility. However, the use of the site must take into consideration the unique problems encountered in construction on old landfill sites. Some uses will be more compatible with the former use of the site than others. For example, using the site for passive recreation will present fewer problems than development of buildings on-site.

The major problems encountered in post-closure development of a site include: differential settlement of the fill; generation of leachate and landfill gas; the need to continually monitor and maintain the facility for up to 30 years and maintaining the effectiveness of the landfill cover. Landfills typically will settle from 10-30% of their original thickness. Landfill leachate and gas will continue to be generated by the landfill for many years and maintenance of the site will be an ongoing concern.

The proposed use must be carefully designed to address each of the factors listed above.

B. Criteria for Post-Closure Use of Landfills

Post-closure use design plans must ensure that the proposed use of the site will protect public health, safety and the environment. The criteria to be addressed include:

- Integrity of the final cover must not be impaired by the proposed use. Design features such as additional cover material may be required to ensure protection of the low permeability barrier layer.
- The landfill must be adequately maintained, including; erosion control, leachate management and mowing of vegetation.
- The final cap, leachate collection system, drainage systems, gas vents or gas collection wells and monitoring program or other features of the landfill designed to protect public health, safety or the environment cannot be adversely affected by the proposed use.
- Gas control technology must be employed where necessary.
- Design and maintenance of the proposed use must address landfill settlement.

CHAPTER 7 LANDFILL GAS CONTROL

I. INTRODUCTION

As solid wastes decompose within landfills, landfill gasses consisting primarily of methane, but also including other constituents such as hydrogen sulfide and vinyl chloride, are produced through the anaerobic decomposition of the solid waste. Methane is a colorless, odorless gas which can be explosive within a range of concentrations of 5 to 15% in air at ordinary pressures and temperatures. The lower explosive limit, or LEL, for methane is a concentration of 5% methane in air. In addition to its explosive nature, landfill gases may kill the vegetation established on the final cover unless adequately controlled.

Landfill gases tend to follow the path of least resistance and may move laterally through refuse and soils, particularly during the winter when soils are frozen. Gases may also be trapped by the final cover which may force gas to move laterally beyond the boundaries of the filled area and into adjacent structures where a threat of explosion would result.

Landfill gas control should be considered and planned for when a facility is designed. Controls should be implemented as a facility is operated and individual phases of the landfill are completed. However, controls can be designed and implemented at the final closure stage, if necessary.

II. REGULATORY REQUIREMENTS

The landfill regulations require at 310 CMR 19.117 that landfills control the concentration of landfill gas as necessary to prevent the occurrence of nuisance conditions or public health or safety problems. Such systems must be designed so as to ensure that the concentration of methane not exceed 25% of the lower explosive limit (LEL) at the property boundary at any time.

At a minimum, the regulations require that passive gas vents be provided in all closed areas of a landfill in order to prevent the build-up of explosive concentrations of landfill gas and prevent off-site gas migration. In addition, gas venting systems must be designed to allow installation of an active gas recovery system should conditions warrant active collection in the future.

The landfill gas monitoring requirements, specified at 310 CMR 19.132(4), indicate that where concentrations of explosive gases exceed the LEL in any on-site structures (excluding gas control or recovery system components) or at the property boundary, a landfill assessment will be required in order to address the scope and severity of the problem.

III. GAS CONTROL

Landfill gas control systems may consist of either passive venting systems, or active collection systems whereby a blower draws gas from the fill through a series of gas extraction wells. Methods used to control gas should be selected based upon the location of the site relative to residences, odor problems associated with the landfill, the depth to ground water, the shape and size of the fill, the age of the facility and the potential for gas migration from the site. When there is a high risk of methane migration to buildings, passive control systems may not be reliable enough to be the sole means of protection.

In addition to control systems installed at the landfill, it may be necessary to install gas detectors and alarms in on-site structures or in off-site structures located in close proximity to the landfill where there is a potential for gas migration off-site.

A. Information Required for Gas Control Design

The following information and data should be provided in order to develop a design for gas control, whether passive or active, at a landfill:

- Physical site characteristics;
- Waste profile;
- Geology and climate;
- History of gas migration incidents or vegetative distress on or near the site;
- Groundwater contours and depth to groundwater;
- Distances to buildings;
- Adjacent land uses;
- Identification of possible migration pathways and patterns;

Much of this information would be collected during a comprehensive landfill assessment, as described in Chapter 5. Since migration patterns and methane concentrations can change rapidly, frequent measurements taken at different times of the year are required to obtain an accurate picture of gas migration patterns.

B. Passive Gas Control

Passive gas control systems rely on natural atmospheric pressure and convection to vent the landfill gasses to the atmosphere. Passive control systems may consist of gravel filled gas venting trenches and/or perforated gas venting pipes installed at the periphery of the filled area of the landfill, or gas barrier walls.

Perimeter systems are designed to prevent the migration of gas off-site by intercepting its movement. Landfill gas may be effectively vented through perimeter gas control trenches or through gas venting wells installed either within the fill or around the perimeter of the site. The decision to use gas venting trenches or perimeter wells will depend upon the proximity of buildings to the landfill, site geology - the depth to ground water or the base of the fill, the effectiveness of gas vents placed in the fill, the quantity of gas potentially migrating off-site, and the amount of space available around the landfill in which a system is to be installed.

1. Gas Venting Trenches

Gas venting trenches are used around the landfill perimeter to prevent lateral landfill gas migration. Continuous trenches with barrier walls should be used in areas where gas migration poses a serious threat to public health and safety. Trench design should incorporate the following features:

- extend to ground water level or below the lowest level of refuse, whichever is less, impermeable boundaries - such as clay;
- be constructed such that the wall of the trench furthest from the fill presents an impermeable barrier to gas flow;
- be filled with crushed stone (1 inch or larger) or other highly permeable material to allow gas to properly vent;

2. Gas Wells

Gas extraction or venting wells are used within the area of the landfill itself or on the perimeter of the site to provide a conduit for the escape of landfill gas from within the fill. Gas well design should incorporate the following features:

- for unlined landfills, be drilled to the water table or the base of the fill, whichever is less;
- for lined landfills, be drilled to approximately 75% of the depth of the fill to avoid damage to the liner;
- be spaced to provide for proper venting of all areas of the fill. Every 50 - 300 feet is typical;
- be screened for the entire depth of well, except in an active system where the screen should stop several feet below the surface of the landfill in order to prevent air from being drawn into the well;
- be backfilled with permeable gravel;
- be properly sealed, particularly in an active system to keep air from being drawn into the well;
- be equipped with sampling ports to enable easy sampling of the gas from the well;

C. Active Gas Control

Active gas control systems are used where landfill gas is to be flared, recovered for its energy value or where landfill gas may threaten buildings or human health. Active systems remove landfill gases by creating a vacuum, which induces gas flow toward the recovery wells.

The Department encourages all landfills to determine whether sufficient gas will be produced to support the generation of power through use of an active collection system. Where sufficient gas is not available a gas flare should be considered in order to destroy methane and non-methane organic compounds (NMOCs), and to reduce odors. Factors which determine whether landfill gas recovery may be economically feasible (as recommended by EPA) include:

- greater than 2 million tons of in-place refuse;
- depth of the refuse is greater than 35 feet;
- landfill area exceeds 35 acres;
- the in-place refuse is of a type which can generate large volumes of landfill gas (such as MSW);
- the landfill will continue to operate or there has been only a short time that has elapsed since the facility has closed;

EPA has reported that one million cubic feet of landfill gas per day at 450 Btu/scf will generate 1250 - 1600 KW/hr of electricity.

While gas yields can be modeled, the best method of obtaining an accurate indication of gas yields is through field measurements. It should be noted that landfills that are significantly smaller than the one described above have successfully and profitably recovered gas for energy.

An active gas control program provides several advantages for the operator, including: environmental control of gas emissions and odors; conservation of natural resources through use of gas as a fuel; a positive community image; and an economic return (Waste Management, Inc.).

The major components of a gas extraction system include:

- gas extraction wells;
- lateral gas well connections;
- gas collection header;
- gas withdrawal fans;
- condensate collection system;

In addition to collecting gas, a gas collection system will produce gas condensate, which should generally be collected and handled in the same manner as landfill leachate. A properly designed gas collection header system will provide for gravity drainage of condensate to low points where it is stored in condensate collection tanks or is piped directly to leachate collection system tanks.

IV. PRELIMINARY INVESTIGATION

The engineering tasks required to design an active collection system on any given site should include the following tasks:

- preliminary evaluation of the site;
- site production test;
- collection system design;
- facility Design;

If a decision is made to move forward with an active collection and gas recovery system, several analyses will be required for submittal of the system design. The following should be submitted with any active collection and gas recovery system application in order to satisfy both solid waste and air quality permit requirements:

- Analysis of the landfill gas, including:
    - CH_4;
    - CO_2;
    - hydrogen sulfide;
    - fluorides;
    - non-methane organic compounds (NMOCs) (EPA Method 624);
- Analysis of condensate;
- Quantity of condensate to be produced;
- Condensate management plan;
- Exhaust analysis for engines or turbine of choice, including the emission rates for:
    - NO_x;
    - CO;
    - CO_2;
    - SO_2;
    - Particulate Matter;
    - Hydrocarbons;
- Noise impact analysis and control for each of the following:
    - Compressors;
    - Engines;
    - Air Inlet;
    - Air Exhaust;
- Summary of all local, state and federal approvals or permits required.

A. Gas Collection System

Gas collection systems must be designed to efficiently collect gas from the gas extraction wells and pipe the gas to a central collection or flaring location. Gas collection piping system design must address settlement of the landfill and to be air tight.

The size and type of blower used to collect landfill gas will depend on the total gas flow rate, the pressure drop presented by the collection system and the vacuum requirements.

The gas collection piping system should be buried wherever possible to minimize vandalism.

B. Gas Flare Stations

Flare stations should be designed such that the destruction efficiency will meet DEP Air Quality standards. In addition, flare stations should be designed with the following:

- automatic shutdown system where the percentage of gas moves beyond set low or high limits;
- flame suppressor;
- automatic restart where the flare is blown out;
- automatic shutdown of the fans should occur where restart does not occur after three tries;

C. Operator Responsibilities

The operator of an active gas collection system will need to carefully monitor operations and equipment. Routine analyses of the gas should also be performed. Operator responsibilities include:

- routine monitoring, data review and interpretation
- visual inspections of the system, including:
    - settlement of wells and header assemblies;
    - stressed flexible connections;
    - vandalism.
- prompt system maintenance and repair:
    - vault settlement;
    - header settlement;
    - pipe integrity;
    - clogging of pipes;
- routine adjustments of the collection system to ensure proper vacuum and gas flow.

D. Monitoring and Data Review

Monitoring of active collection systems should include:

- Perimeter Probes:
    - methane concentration;
    - pressure;
- Extraction Wells:
    - methane concentration;
    - oxygen concentration;
    - nitrogen concentration;
    - pressure;
    - gas flow;
    - available header vacuum;
- Flare Station:
    - methane concentration;
    - oxygen concentration;
    - gas flow;
    - blower inlet and discharge pressure;
- Engines or Turbines.

E. Condensate Management

The condensate collected within a landfill gas collection system must be properly managed. A condensate management plan must be part of any gas collection system design. Guidance on management of condensate follows:

- In unlined landfills, condensate should be collected and stored within collection tanks. These tanks should be pumped periodically and the condensate should be properly disposed.
- In lined landfills condensate collected within condensate traps may be allowed to return to the filled area beneath the final cover, or collected and be properly disposed.
- Condensate holding tanks should be double-walled and be equipped with a full tank alarm system.

V. CONCLUSIONS

Landfill gas assessment and control is an area which has become a concern to the Department particularly in suburban and industrial areas where development and construction has reached landfill borders.

This Chapter is the Department's first attempt to provide guidance relative to landfill gas. As such, the guidance is not complete, and will change as more information is learned by staff and consultants conducting field work. The Department welcomes proposals from consultants with innovative methodologies for conducting landfill gas assessment activities and designing control measures.

CHAPTER 8 LANDFILL RISK ASSESSMENT

I. INTRODUCTION

This chapter will discuss generally the purpose for and process of conducting a risk assessment. It will describe the two part process for assessing the public health and environmental risks associated with a solid waste landfill and the steps involved in completing each component part.

II. PURPOSE

One of the first steps in developing a suitable closure strategy for a landfill is the identification of risks to the environment and the public health which may have been caused by its long term operation. A landfill risk assessment is structured to provide information on how contaminants emanating from the landfill may have effected nearby centers of population. A risk assessment attempts to answer the following questions:

- Does contamination exist which may effect people and the environment nearby?
- What health effects may be linked to exposure to contaminants from the landfill?
- How likely is it that people will come in contact with these contaminants?
- Is the contamination having an adverse impact on the environment?

III. PROCEDURES

These questions are answered in two parts. In the initial qualitative risk assessment four steps are employed - identification of contamination, identification of receptors, identification of pathways and conclusion/recommendation - to determine if significant levels of contamination exist and whether the quantitative risk assessment will be required.

If the subsequent quantitative risk assessment is justified, five steps are employed - hazard assessment, dose-response, exposure assessment, risk characterization and uncertainty analysis - to more systematically define the risks present and to assist in developing a plan for corrective action.

A. Part One - Qualitative Risk Assessment

At the conclusion of the second phase of a solid waste landfill assessment (the Comprehensive Site Assessment or CSA phase), a qualitative risk assessment must be undertaken. The four basic steps involved in conducting a qualitative risk assessment are briefly described below.

1. Identification of Contamination

Monitoring data is summarized in an easy to understand format. Graphs are used which show trends for each media sampled over time. Data points of greatest concern are highlighted.

2. Identification of Receptors

Both public health (people) and environmental (surface waters, wetlands, areas of critical environmental concern, wildlife habitats) receptors are identified. Receptors are shown on a map in relation to the landfill.

3. Identification of Pathways

Physical pathways by which documented contamination (from monitoring data identified above) is likely to reach receptors are identified. All pathways (each incidence of contamination in each media where a likely pathway exists) are shown on a map.

4. Conclusions and Recommendations

If all the information taken together and presented in a logical fashion as described above indicates that there is little risk to public health and the environment from the landfill, it is recommended that the risk analysis exercise is complete. This may be due to the absence of contamination, the remoteness of the site, the age of the landfill or other factors. If, on the other hand, the data indicate that a more thorough study of the risks should be undertaken (a quantitative risk assessment), it is recommended that further, more in-depth study is appropriate.

B. Part Two - Quantitative Risk Assessment

If significant contamination is present and likely to threaten receptors, or if an alternative closure option is desired, it will be necessary to proceed to the second risk assessment phase, the quantitative risk assessment. In certain cases this additional phase is necessary to more systematically identify and explain the risks existing at the site. Contamination data from the CSA and data presented in the qualitative risk assessment should be used to frame this subsequent analysis. The five steps involved in conducting a quantitative risk assessment are briefly described below.

1. Hazard Identification

In the hazard identification step, chemicals in the landfill which might pose a threat to people and the environment are studied. Certain chemicals might cause harm if groundwater, runoff, soil, or air is contaminated with them. First, the ways in which people may come into contact with the chemicals is determined. Second, samples of media at and around the landfill are taken (or analyzed if data exists) to determine how the chemicals may have migrated within the landfill. Finally, a toxicity profile is created in which the properties of chemicals of concern are described. Existing guidelines which summarize known health hazards and clean-up levels should be used.

2. Dose Response Assessment

A dose-response assessment lists harmful effects in humans and animals attributed to specific doses of chemicals present in the landfill. Two types of chemicals must be evaluated; non-carcinogenic and carcinogenic.

For a non-carcinogenic chemical, it is thought that there is a threshold dose, a level at or below which no harmful effects will exist. It is difficult to establish such a level, so a human sub-threshold dose must be found. (This is an approximate amount which causes no hazardous effects to people.) The route of dose, duration of exposure, absorption efficiency and age of person receiving the dose is examined to develop a sub-threshold dose. The US EPA derived Reference Dose should be used in evaluating chemicals of concern.)

For a carcinogenic chemical, there is no dose at which there is zero risk. This means any exposure at all to a carcinogenic substance creates a health risk for a person. Each carcinogenic chemical present in the landfill must then be classified by placing it in group A, B, C, D or E. (Group A substances have been found to be carcinogenic to humans; Group B substances are probable carcinogens; Group C substances are possible human carcinogens; group D substances cannot be classified as cancer-causing; and group E substances have no evidence of being carcinogenic.) Carcinogenic substances must also be evaluated for potency value, their cancer causing potential. In a Dose-Response Assessment, all compounds must be analyzed including PAHs, dioxins, and PCBs. Carcinogenic compounds must also be evaluated for non-carcinogenic effects.

3. Exposure Assessment

The exposure assessment asks the question: If the site is not remediated, will the chemicals present in the landfill cause risk? Here, all potential human receptors are identified. Most likely receptors are workers at the landfill, residents of the town, trespassers, and children who play near the landfill.) Exposure routes are also determined. First, releases are identified, such as buried waste. Second, media which might allow exposure to people, like groundwater used for drinking are identified. Third, the ways in which the chemicals move from the release source through each media are distinguished. These three elements together make up the migration pathway. Finally, the way in which a person might be affected by the chemicals, either through breathing, eating, or skin absorption is detailed.

4. Risk Characterization

In a risk characterization, exposure point concentrations of the chemicals of concern are compared to standard concentrations. This comparison aids in determining carcinogenic and noncarcinogenic risks. If it is determined that the chemicals in the landfill will cause significant health risks, the site must be remediated. However, this does not mean that the contaminants in the landfill necessarily will harm the environment or humans. Risk assessment is a tool which cannot with certainty show a cause-effect relationship.

5. Uncertainty Analysis

Uncertainty analysis shows the inaccuracies which might occur in a risk assessment. Sources of uncertainty might occur in taking environmental samples, determining exposure point concentrations, developing a toxicological profile or in determining the different exposure pathways.

IV. CONCLUSIONS

In most cases, a qualitative risk assessment will be sufficient to address questions about potential health and environmental concerns at a landfill. The four step process outlined above, required to be completed at the conclusion of the Comprehensive Site Assessment, will serve to summarize and analyze data in an easy-to-understand format. If, however, a serious concern about potential risks is present, the subsequent five step quantitative risk assessment must be undertaken. This analysis will more systematically define and analyze the health and environmental impacts of the landfill, and inform a decision about site corrective action.

CHAPTER 9 SUPERFUND TECHNOLOGY COMPARISON

I. INTRODUCTION

As part of the EPA Grant, a study was conducted to determine the solid waste landfills which have been remediated under the Federal Superfund program. The intent of the study was to determine what similarities existed between a typical municipal landfill which would undergo the landfill assessment and closure process and the Superfund landfills. By doing this we hoped to see which technologies used in Superfund could be applied to municipal landfill activities, and which technologies were not appropriate.

The study focused on Superfund landfill sites within the northeastern United States and evaluated remedial options, pre-cleanup landfill conditions, and costs associated with landfill closing in a wide range of situations. It was discovered that most of the Superfund landfills were more environmentally severe than typical municipal closing.

The study surveys 20 Superfund landfill sites and presents a general characterization of the conditions of the landfill and the resulting remedial action.

II. SITE CHARACTERIZATION

Twenty Superfund landfill sites were characterized in very broad terms. The sites were gathered from EPA Regions 1, 2, and 3 and were limited to landfills that were initially or at some time municipal landfills. The characterization of the landfills that ended up on the NPL included the following and are presented in Appendix D.

1) acreage of the landfill;
2) years of operation;
3) landfill condition;
    a. lined/unlined;
    b. capped/uncapped;
    c. existing leachate, surface water, or gas collection system;
4) types of waste accepted;
5) threats posed to public health;
6) remedial options chosen and associated costs;

A. Acreage

The average acreage of the Superfund sites was 40.65 acres with a minimum of six and a maximum of ninety acres. The variance in the size of the landfills was extreme, as exhibited below:

Acreage	#landfills
greater than or equal to 50	8
between 30 and 50	3
less than or equal to 30	8

B. Years of Operation

The average years of operation of the landfill was 26.7 years with a minimum of 4 years and a maximum of 56 years. Once again, a large range of operational years was evident, as shown below:

Years of Operation	#landfills
greater than or equal to 40	7
between 20 and 40	6
less than or equal to 20	7

C. Landfill Condition

Only 1 out of the twenty landfills, the Strasburg Landfill in Newlin, Pennsylvania, was constructed with a liner. Not surprisingly the 20 mil polyvinyl chloride lined landfill was recently constructed in 1979. 6 of 20 landfills were already capped to varying degrees before the Superfund Program was imposed.

Existing recovery systems for surface water, leachate and gas emission control, usually previously required by state and local authorities, were never up to EPA standards, as systems were always upgraded in order to comply with Superfund regulations. Some form of leachate collection systems, which sent leachate to everything from on-site impoundments to on-site treatment, existed at six of the 20 Superfund landfills before EPA action. Gas emission control was already evident at two of the twenty landfills.

D. Types of Waste Accepted

The types of waste accepted were varied but in 90% of the cases there was documented hazardous/industrial waste dumping in the landfills. (Documented meaning that the EPA record of decision includes the likely dumping incident or practice that caused the problem). The sources of the documentation were numerous and had varied levels of integrity - strict record keeping of the landfill itself, recollections of past landfill managers, actual observations of waste practices, etc.

E. Threat to Public Health

The overwhelming threat to public health was the threat to drinking water wells near the site. In 18 of 20 of the cases environmental professionals had concluded that the landfill represented a threat to drinking water supplies. 11 of the 20 landfills had already caused private drinking wells in the area to be contaminated above volatile organic compound (VOC) drinking water standards and one landfill had actually contaminated a municipal supply well.

Table 1 lists the well already contaminated by the landfill, the nearest public or residential well threatened, and the level of groundwater contamination found beyond the landfill boundaries. High levels refers to a maximum VOCs level above or equal to 1 mg/l and low levels refers to a maximum below 1 mg/l.

F. Remedial Options Chosen and Associated Costs

The remedial options chosen in the Superfund cleanups through the criteria of risk reduction, compliance, effectiveness, and implementability are also listed in Table 1. All the sites required a cap. All EPA required caps, unless otherwise indicated contained a vegetative cover, a surface water drainage layer, a passive gas vent, and an impermeable layer. The type of impermeable layer was the major source of variability in cap construction. 6

of 20 required a clay cap. 4 of 20 required a flexible membrane liner cap. 3 of 20 landfills required a clayey soil cover and 5 required the RCRA standard FML/clay composite liner.

Six of landfills went beyond passive gas collection. the Florence Landfill used passive gas collection with carbon treatment. The Gems Landfill, Landfill & Resource Recovery Landfill, and the Combe Fill South Landfill employed active collection with gas flaring. The Moyer Landfill and the Old Bethpage Landfill employed active collection and energy production of their landfill gases.

20% of the sites needed a slurry wall to contain groundwater and leachate migration. 30% needed an alternative water supply to reduce the risk to public health. 65% required a groundwater recovery system.

Costs varied a great deal due to different remedial schemes required of landfill cleanups. The wide variety of landfill sizes leads to huge differences in costs due to differences in cap size required. In general the larger landfills cost more due to the cost of the cap. The necessity of groundwater recovery also generally added a great deal to the costs. The significance of cost comparisons are hindered by the small sample size and the huge variance in landfill conditions, acreage, and threats resulting in extremely varied remedial expenditures.

Costs	# landfills
Greater than or equal to $25 million	6
Between $25 and $10 million	7
Less than or equal to $10 million	7

Costs averaged $18.865 million or $662,000/acre with a high of $69 million and a low of $0.3 million. The average cost per/acre of sites with groundwater recovery is $843,000 and without the cost is $350,000/acre.

III. CONCLUSIONS

As stated initially, nearly all of the Superfund sites in the study had some history of hazardous waste dumping. In most cases, this resulted in closure alternatives in excess of a clay or composite cap.

All of the municipal landfills undergoing assessment and closure will require a cap as specified by the State solid waste regulations, and many will require passive gas and leachate collection. It will be on rare occasions that municipal landfills need to install active leachate and gas collection, alternative water supplies, and groundwater treatment which drive up closure costs.

PART II. ADMINISTRATIVE GUIDANCE

This Administrative Guidance is meant to assist municipal officials, solid waste committee members, and landfill owners and operators to prepare for assessment and final closure of their sanitary landfills.

Chapter 10 addresses the costs of landfill assessment, closure, and post-closure. Chapters 11 amd 12 discuss financing, fees and accounting considerations associated with solid waste management. Chapter 13 discusses the contracting process and Chapter 30 B considerations. A model Request for Proposal (RFP) is included Appendix E for use in procurement of contracting services.

Chapter 14 and 15 discuss municipal planning activities for landfill assessment and closure implementation, and how the process fits into the integrated solid waste management framework.

The Section as a whole will provide information and techniques which will make the landfill assessment and closure process proceed more smoothly and keep costs to the minimum level necessary to protect public health, safety and the environment.

CHAPTER 10 LANDFILL ASSESSMENT AND CLOSURE COSTS

I. INTRODUCTION

This chapter provides an estimated cost breakdown of the assessment, closure, post-closure and corrective action components of the Solid Waste Management Facility Regulations.

A. History of Solid Waste Regulations in Massachusetts

The primary statutory authority for the management of solid waste facilities is MGL c.111, s.150A which authorizes boards of health to assign land for solid waste management purposes and authorizes the Department to permit solid waste facilities. The 1971 solid waste regulations were established to: 1) outlaw "open dumps"; 2) require that sanitary landfills be sited, designed, operated and closed in such manner as to protect public health, safety and the environment, and; 3) prevent "the occurrence of conditions of air, land and water pollution and to assist in the abatement of such conditions when and where such pollution may occur." (Preamble to the 1971 regulations.)

PART II of the regulations is a restatement and revision of the 1971 landfill regulations providing performance and design standards as well as revised operations and maintenance requirements. These broad environmental and health protection objectives have been restated in the form of strict performance standards in design and operations. In the 1990 regulations the technical requirements necessary to meet these standards have been established, and engineering flexibility to respond to site specific variations and advances in technology has been retained.

The 1990 modifications are the result of the Department's experience with landfills that have adversely impacted water supplies and other natural resources. The revisions reflect an improved understanding of the geological and hydrogeological factors affecting landfill discharges and the significant technical advances in design, materials engineering and environmental monitoring and testing.

Other laws and regulations have been enacted since issuance of the 1971 regulations which directly affect landfill design and operations. These include the Site Assignment Regulations, 310 CMR 16.00, which establish uniform siting criteria and procedures for siting solid waste management facilities; 314 CMR 3.00 and 5.00 which outlaw discharges of pollutants to surface waters and ground waters, respectively, without a valid permit as provided in MGL, c.21, s.43; the Wetlands Regulations, 310 CMR 10.00; and the Air Quality Control Regulations, 310 CMR 7.00. In addition, the 1990 solid waste regulations incorporate many of the provisions in the draft federal RCRA Subtitle D regulations such as language on bird hazards, groundwater protection standards and monitoring requirements.

II. ASSIGNMENT AND CLOSURE COSTS

A. Variables and Limitation of this Analysis

Consistent, facility specific projections of financial impact are difficult to develop for several reasons. First, estimates are affected by site-specific variables. For example, site-specific factors which will determine the total cost of constructing, operating and closing a landfill include hydrogeological features, the local availability of clay for liners and capping material, the amount of site preparation work required and the topographical features of the site which may require special consideration in design. Secondly, the Department lacks data which breaks out the cost components of landfill assessment and closure based on recent standards.

Another consideration which is difficult to factor into cost estimates is economies of scale. EPA notes in its background document for the proposed RCRA Subtitle D solid waste regulations that there are substantial economies of scale for landfill construction costs. Participation by communities in regional landfills allow smaller communities to take advantage of these economies of scale, even with the additional costs of transfer stations and transportation. A major goal of Chapter 584 the Solid Waste Act of 1987, is to encourage the development of such regional solutions to waste disposal.

B. Costs of First Year Environmental Site Assessment

The following are estimates of the costs associated with the Landfill Assessment and Cleanup (LAC) program. The estimates have been calculated to represent a typical municipal sanitary landfill which has undergone limited prior assessment. Included in the costs are the first year of quarterly environmental sampling. Table 10-1 provides a breakdown of assessment costs for each of the required tasks.

C. Landfill Final Cover Systems

An effective final cover system is critical in minimizing the amount of precipitation which will percolate into the landfill yielding leachate. An impermeable cap will significantly reduce leachate and the costs associated with its collection and treatment over the post closure period. As seen in Table 10-2 the cost of a final cover system under current regulations and policy is $80,000 - $90,000 per acre. As with liners, alternative designs will be acceptable to the Department as long as they are equivalent to the stated design. One possible alternative is to use synthetic capping materials rather than low permeability soils.

D. Post-closure Monitoring

The proposed regulations extend the period of post closure monitoring from a period of one year after final capping to a minimum of 30 years. Depending on the size of the site and the maintenance activities required the cost may range between $30,000 to $100,000 for the entire post closure period.

E. Related Cost Considerations for Landfills

1. Remediation Costs

A primary goal of the proposed regulations is to prevent contamination of ground water. Landfills with poorly designed and/or constructed ground water protection systems will pollute groundwater, resulting in the need for remedial measures and potential liability exposure against owners and operators for damages caused to persons and property from the migration of pollutants from the landfill. Prevention of contamination is therefore generally more cost effective than cleanup of contamination after the fact. Remediation activities may vary greatly in level of complexity, from simply closing and capping a site to extraction of ground water with subsequent treatment and discharge.

Table 10-1: Assessment Costs

INITIAL SITE ASSESSMENT (ISA)	Low	High
TASKS:		
1. Background Information	$300	500
2. Historical Research	$450	600
3. Literature/Data Search	$750	1500
4. Hydrogeological Description	$400	600
5. Site Visit	$300	500
6. Mapping	$1100	5000
7. Field Screening	$1500	5000
8. Development of Comprehensive Solid Waste Site Assessment Scope of Work.	$1200	2500
SUBTOTAL	$6000	16200
COMPREHENSIVE SOLID WASTE SITE ASSESSMENT (CSA)		
TASKS:		
1. ISA Summary	$100	250
2. Mapping	$1500	4000
3. Drilling Program !	$6000	25000
4. Estimation of Hydraulic Conductivity	$2000	5000
5. Sampling and Analysis !!	$20000	30000
6. Health and Safety Plan	$750	1500
7. Project Schedule	$150	250
8. Report Preparation	$5000	10000
9. Development of Preliminary Closure Alternatives Analysis Scope of Work	$1500	2500
SUBTOTAL	$37000	78500
! (1500 - 2500 per well)		
!! (4 rounds of 10 samples @ 500 - 750 per sample)		
TOTAL RANGE	$43000	94700
BASELINE RISK ASSESSMENT (Qualitative)	$2500	5000
CORRECTIVE ACTIONS ALTERNATIVE ANALYSIS	$40000	60000
CLOSURE DESIGN ENGINEERING COSTS	5% of Closure Construction	

Examples of typical costs for various remedial measures are included in Tables 10-3 and 10-4. These costs are included only as examples of the types of expenses which may be incurred in cleaning up contaminated ground water at landfills. Costs for remediation of other types of contamination, such as contamination of surface water or landfill gas exposure, are not included. Costs will vary with each site, with the type of remedial measure chosen and the extent to which ground water will be cleaned up. In some cases it may be more cost-effective to establish new sources of drinking water.

Table 10-2: Cost Range for Closure and Post Closure Activities

Component	Cost/Unit	Cost/Acre
CLOSURE *		
Final Cover	$4.20 - $9.50 cy	
Seed/Fertilizer/ Mulch		$1,000 - $1,500
Soil Testing		$150 - $250
Ditches	$.50 - $2.00 lf	
Sedimentation basin	$5,000 - $15,000 each	
Gas Venting Trench	$4 - $6 lf	
Gas Extraction System	$50,000 - $250,000	
Leachate Head Wells	$1,000 - $10,000 each	
Survey and Certification	$2,000 - $10,000	
Landscaping	Variable	
Administration	5% of Total	
Estimated Total		$80,000 - 90,000/acre
POST CLOSURE **		
Annual Inspections	$1,000 - $9,000	
Land Surface Care	$500 - $1000/yr	
Leachate Hauling and Treatment	$0 - $36,000/yr	
Environmental Monitoring	$2,000 - $10,000 per round	
Estimated Total	**$3,500 - $56,000/yr**	

2. Federal Solid Waste Regulations

The U.S. EPA issued new solid waste regulations under Subtitle D of the Resource Conservation and Recovery Act (RCRA) on October 9, 1991. These regulations contain siting, design, operation, monitoring, closure and post-closure requirements for landfills and apply to landfills which accepted waste after the effective date of October 9, 1991, although criteria other than final cover will not apply to landfills which close prior to October 9, 1993.

The Massachusetts solid waste regulations parallel the Federal regulations and have provisions which are as stringent or more stringent than most of the Federal criteria. Massachusetts will be applying to become an approved state under the State/Tribal Implementation Rule (STIR). Under that rule the state's regulations will be reviewed to determine that they contain provisions which cover all the criteria established in the Federal regulations. Should the state not receive approval, the Federal regulations are self-implementing. This means that any facility to which the regulations apply is required to meet all the criteria in the federal regulations and put demonstrations to that effect in an operating record. Failure to comply with the federal regulations can result in federal court actions brought by EPA or through private citizen suits.

III. CONCLUSIONS

All landfills will inevitably be affected by the landfill assessment requirements. Existing landfills which are not expanding will be affected by the closure/post-closure requirements in the solid waste regulations. While the new assessment and closure regulations will result in increased costs for services and materials, it will also result in better protection of groundwater as well as decrease the amount of leachate which must be collected and treated in landfills equipped with a groundwater protection system.

The costs associated with design, construction, operation and closure of landfills must also be compared against the potential costs of remedial measures where landfills not designed, constructed, operated or closed in accordance with these regulations pollute groundwater or surface water. Remedial measures are expensive, in many instances more expensive than replacing groundwater drinking supplies.

Table 10-3: Remediation Costs for the Charles George Landfill*

Remediation System	Capital Costs[1]	Annual O&M Costs[2]
GW Extraction System	$ 1,064,000	$ 42,000
No Action Alternative	$ 151,000	$ 113,000
Extraction, Carbon Absorption, Discharge	$2,995,000	$ 686,000
Extraction, Air-stripping, discharge	$ 2,893,000	$ 695,000
Extraction, Biological Treatment, Discharge	$ 2,585,000	$ 750,000
Off-site Treatment and Disposal	$ 1,861,000	$12,259,000

* Costs estimated for a 70 acre landfill now on the Superfund list.

1. Includes construction costs of components, site preparation, utilities, engineering, permitting and contingency costs
2. Includes annual maintenance and operational costs and materials and electricity

Table 10-4: Remediation Costs* for a Hypothetical 10 Acre Landfill (From Tolman, et al., 1978)

GROUNDWATER CONTROLS

Remediation Method	Average Est. Costs
Bentonite Slurry Trench	$ 670,000
Grout Curtain	$1,400,000
Sheet Piling	$ 800,000

PLUME MANAGEMENT **

Remediation Method	Average Est. Costs
Drains	$ 23,000
Well Point Dewatering	$ 185,000
Deep Well Dewatering	$ 183,000
Injection/Extraction Barrier	$ 199,000
Spray Irrigation	$ 366,000
At-Grade Irrigation	$ 32,000
Subgrade Irrigation	$ 28,000

* For a hypothetical 10 acre landfill. Costs are average of high and low cost estimates.

** Costs include present worth of 20 years, operation, maintenance, and, where applicable, power for 10 acre landfill.

CHAPTER 11 SOLID WASTE FEES AND RATE SETTING

I. INTRODUCTION

This chapter addresses the basic financial management of integrated solid waste management in Massachusetts cities and towns. Financial management as discussed in this chapter focuses primarily on the rate setting process, including:

- Sanitary landfill life-cycle costing
- Cost identification and projection
- Account classifications
- Alternative fee structures
- Revenue requirement estimation
- Rate calculation
- Impact analysis

Communities are encouraged to establish user fees to recover the total costs of ISWM as described herein, including closure and post closure costs. The next chapter, Accounting Support Systems, discusses several accounting options and the accounting requirements for closure and post closure costs. Due to the complex legal and accounting requirements, communities are encouraged to discuss these matters with Town Council or City Solicitor and staff from the Department of Environmental Protection and Department of Revenue.

Financial management of solid waste is authorized in Massachusetts General Laws Chapter 44, Section 28C. Sub-section(f) authorizes any city or town to fix, revise, charge, and collect such fees and other charges, for any facilities or services provided as relating to the collection or disposal of solid waste. This sub-section authorizes a city or town which has issued debt obligations to provide revenues through user fees or other charges at least sufficient to pay the current expenses of operating and maintaining such facilities and services, to pay the principal (including premium, if any,) and interest on all debt obligations issued, and to create and maintain such reserves as may be required, and to provide funds for paying project costs and maintenance, repair, replacement and renewal costs with debt obligations issued, and to pay or provide for any and all amounts which the city or town may be obligated to pay by law or contract relating to such a project. In addition, this sub-section authorizes a city or town to establish and adjust such fees and charges so as to provide revenues sufficient to pay costs incurred by the city or town to clean up or prevent pollution caused by existing active or inactive landfills or other solid waste facilities. Such fees and charges may be fixed and adjusted by each city or town to cover all or any part of the costs specified above. This sub-section also requires a community to provide funds for the estimated cost of closing any existing operating solid waste facility and to clean up any pollution counsel by an inactive landfill in a separate fund or funds for subsequent appropriation for such purpose.

Sub-section (g) authorizes a city or town to contract for the operation by others of any solid waste facility financed or to be financed by such city or town. In addition, other cities, towns and other public agencies and private parties, are also authorized to contract with any city or town or with any operator for the disposal of refuse, garbage and waste, or to purchase or use by-products or residue resulting from the operation of such facilities.

Sub-section (a) defines costs broadly to include all or any part of the costs of planning, designing, acquiring, constructing, reconstructing, altering, remodeling and otherwise carrying out such work or purpose including, without limitation, the cost of labor, materials, machinery and equipment, lands, structures, and all rights of any kind in real and personal property, costs of demolitions and relocations, cost of issuance and other financing charges and expenses, reserves for debt service and other capital and current expenses, cost of architectural, engineering, financial, legal and consulting services, cost of plans, specifications, appraisals, surveys, inspections, financial and feasibility studies, and any other costs or expenses authorized necessary or incidental to the planning, acquisition, construction, financing, or placing an operation of such work or purposes. Costs shall also include interest prior to, during, and for a reasonable period of time after completion of such work or purpose.

In addition, sub-section (b) authorizes a city or town to issue debt to pay for project costs for:

- Cleaning up or preventing pollution caused by existing or closed landfills

- Constructing incinerators, refuse transfer facilities, recycling facilities, composting facilities, for the purpose of disposing of waste, refuse and garbage.

- Remodeling, reconstructing or making extraordinary repairs to incinerators, refuse transfer facilities, recycling facilities, resource recovery facilities or other solid waste disposal facilities, for the purpose of disposing waste, refuse and garbage.

- Closing out a landfill area, opening a new landfill area, or making improvements to an existing landfill area.

Debt, however, cannot be incurred until the Massachusetts Department of Environmental Protection approves the plans relating to the project for which debt is to be incurred. A two-thirds majority vote of the authorizing body is required to incur debt for such purposes. The useful life of a project to clean up or prevent pollution caused by existing or closed landfills or other solid waste facilities is deemed to be thirty years. A city or town may issue short-term notes, not exceeding three years from the date of issue, or six months after the date of completion of the project.

II. SANITARY LANDFILL LIFE-CYCLE COSTING

Cost analysis of activities occur in three time periods or phases: during the active landfill period, during the closure period, and during the post closure period. In making the transition from one phase to the next, a community needs to take a hard look at the activities which will be ongoing and establish costs for each activity. These cost estimates will be necessary in order to implement a long-term user fee and segregated accounting systems. The sections below provide a summary of the likely activities which will occur in each phase. In establishing a fee and/or segregated accounting system, communities should determine which activities will occur and make a best estimate of the costs related to each activity. Refer to the Accounting Support System chapter for a detailed discussion of accounting issues.

A. Active Phase

The active phase of the landfill life-cycle provides a municipality with an opportunity to recover its total operating costs and provide a reserve for

The total annual costs of a utility are made up of:

- Operating costs - The annual, recurring costs of the management, maintenance and service activities of the utility.
- Capital costs - Expenditures related to the acquisition or addition of fixed assets.
- Reserves - The annual contribution to a landfill closure and post closure reserve.

The operating costs can further be categorized as:

- Direct costs - the costs of operating the utility that are clearly identifiable and associated with its operation such as staff, materials, supplies, and contractual services.
- Indirect costs - those elements of cost which are not an integral or direct cost of the service provided such as insurance, pension, health care which are budgeted separately from ISWM costs; and overhead costs such as management time, computer time, collector/treasurer and other costs.

It should be noted that different communities may define "direct" and "indirect" costs differently, according to their own budgeting and accounting practices. The definitions used in the manual represent the most common treatment of these costs by Massachusetts municipal governments.

B. Operating Costs - Direct Costs

The direct costs of operating the utility normally include the following:

Personal Services:
- Management Salaries
- Staff Wages
- Overtime
- Other Premium Pay (longevity, differentials, etc.)
- Contractual/Professional Services:
- Equipment Maintenance
- Testing
- Engineering Studies

Non-Personal Services:
- Electricity
- Travel
- Uniforms

Supplies:
- Chemicals
- Materials

Capital Outlay:
- Scales
- Buildings
- Vehicles
- Other Equipment

Debt Service:
- Principal
- Interest

The direct costs of ISWM operations may be clearly identified in the municipal budget (appropriations) and in the general ledger under separate ISWM activity budgets with various line-item accounts. In instances where the municipality does not budget for ISWM operations as separate budgeting programs or activities, then the budget/accounts of the Department of Public Works or appropriate organizational unit must be analyzed to derive the personal services and other cost categories related to these operations.

C. Operating Costs - Indirect Costs

The cost of services provided by other municipal departments which benefit the ISWM system should be included in computing the total operating costs of ISWM operations. Whether these costs are considered "direct" or "indirect" within a community's ISWM cost accounting practices, they should be included in the compilation of total costs and revenue requirements in order to fully account for the municipality's costs for ISWM services.

Typical indirect costs of ISWM operations include the following:

Services/time of:

Chief Executive Officer (Town Administrator, Executive Secretary, Mayor)
- Accountant/Auditor
- Budget Office
- Purchasing Office
- Treasurer/Collector's Office

- Computer Services

- Postage

- Central Motor Pool

Employee Fringe Benefits
- Pension
- Health Insurance
- Life Insurance
- Worker's Compensation

Municipal Insurance
- Comprehensive General Liability
- Automobile
- Property Damage
- Public Official's Liability
- Fidelity And Crime
- Boiler and Machine

D. Indirect Cost Allocation

The allocation of indirect costs requires that additional cost data be collected and that an appropriate allocation method be applied in order to properly allocate these costs to the ISWM utility.

In general, indirect costs should be allocated to ISWM operations based upon reasonable allocation formulas, supported and documented by available statistics and municipal records whenever possible. Examples of allocation methods for some indirect costs are as follows:

Cost	Allocation Method
Chief Executive Officer's times (Mayor, Town Manager)	Annual salary times % of total municipal budget comprised of ISWM budget
Accountant/Auditor time	Salary times ISWM warrants or vendor checks as % of total
Computer Services	Machine time related to ISWM bill preparation
Motor Pool	ISWM vehicles as % of total pool vehicles
Health Insurance	Actual premiums for ISWM personnel, or ISWM positions as % of total cost pool
Pensions	Proportion of ISWM personnel (as % of total employees) times annual pension appropriation or actual payouts

E. Capital Costs

In addition to direct capital outlay expenditures, ISWM systems require periodic, large capital investments for the improvement of the landfill or solid waste facility. These major capital improvements are normally funded through long-term bond issues. Capital improvement costs for the rate study period will therefore include the costs of principal and interest (debt service costs) on existing long-term debt for ISWM system purposes and any new debt issues planned during the rate study period.

The rate study should include the costs of debt retirement and identify both principal and interest payments due on outstanding bonds. Also, interest costs related to ISWM bond anticipation notes (BANs) should be included. Existing debt repayment schedules are available through the municipality's Treasurer, and planned debt issues to fund infrastructure should be reviewed with the utility manager or DPW Director and cost projections based upon design and construction estimates. The anticipated debt retirement schedules and projected interest rates should be determined in collaboration with the municipality's treasurer or chief financial officer.

F. Closure and Post Closure Costs

Landfill closure and post closure costs are expensive. Communities should estimate closure and post closure costs and establish reserves for landfill closure and post closure costs by including in its rate analysis an annual amount to be set aside to establish a reserve. Annual contributions to this reserve will avoid or minimize rate shock in future years and provide compliance with Massachusetts General Laws.

G. EPA Funding Requirement

The current EPA funding requirement is that a community is required to fund closure costs as of April, 1994 if the community accepts waste after October, 1993, unless the state establishes a different rule. The current funding formula is the closure and post closure cost estimate of the area used plus the area in use divided by the number of years remaining in the permit period or remaining useful life, if shorter. Notwithstanding EPA funding requirements, communities are required by Massachusetts General Laws to clean up any pollution caused by active or inactive facilities.

The GASB will not be addressing the funding issue.

IV. ACCOUNT CLASSIFICATIONS

Communities are encouraged to utilize the account classifications of the Uniform Municipal Accounting System (UMAS) as promulgated by the Massachusetts Department of Revenue, Bureau of Accounts. Budget and account classifications generally should conform to the following classifications.

Budget/Expenditure Accounts

5100	Personnel Services
5200	Contractual Services
5400	Supplies
5600	Intergovernmental
5700	Miscellaneous
5800	Capital Outlay
5900	Other Financing Uses

Estimated Revenue/Revenue Accounts

4100	Taxes and Excises
4200	Charges for Services
4400	Licenses and Permits
4500	Federal Revenue
4600	State Revenue
4700	Other Intergovernmental Revenue, Special Assessments, Fines and Forfeits
4800	Miscellaneous Revenue
4900	Other Financing Sources

At the time of the writing of this manual, the Bureau of Accounts is considering changes to the UMAS system. Communities are encouraged to consult with their Town Accountant/City Auditor for current and revised classifications.

V. REVENUE REQUIREMENT ESTIMATION

The cost of the ISWM utility is the total of the direct, indirect, capital and reserve costs associated with its operations. The total costs are generally recovered through the utility's user charge. The revenue requirements to be met through the user charge are also a function of:

- The municipality's cost recovery objectives

- Other ISWM revenues available to offset the costs of ISWM operations

A. Cost Recovery Objectives

As part of the rate setting process, municipal officials must reach a decision as to their cost recovery objectives for ISWM operations: full cost recovery, recovery of operating costs only, recovery of some percentage of total costs, etc. This policy decision is one of the factors that will affect the utility's net revenue requirements to be recovered through a user charge.

B. Other Revenues

Normally the revenues collected from each year's ISWM rates will not recover the total costs of the system as there are other utility-related annual revenues that will offset the cost of operating the utility. A municipality may impose or collect all or some of the following revenues:

- Liens - Massachusetts law allows a municipality to establish liens on real property for non-payment of ISWM use charges. Under this procedure any unpaid ISWM charges are added to the property owners' real estate taxes on an annual basis. (While liens are not, technically speaking, "additional" ISWM revenues, they must be estimated apart from revenues directly related to current year rates, and are therefore described as other revenues in this section.)

- Grants - Federal, state or other grants may be available to fund operating or capital costs.

- Interest - Interest revenue is credited to ISWM if an enterprise fund is adopted.

VI. ALTERNATIVE RATE STRUCTURES

There are several alternative fee systems which can be considered by municipalities for ISWM. More and more Massachusetts municipalities are turning to trash fees as an alternative revenue source to finance integrated solid waste management. In a recent Massachusetts Municipal Association survey on trash fees, of the 174 Massachusetts municipalities responding, 80 were charging trash fees. 50 communities charged for landfill stickers for the use of a municipal landfill or transfer station. Of the remaining 30, 14 communities charged a commercial trash collection fee and 16 charged a residential trash fee. The alternative trash fee structures include:

- Flat fee

- Graduated fee

- Per bag fee

- Sticker fees

- Card punch fees.

Each of these alternative rate structures ia briefly described below.

A. Flat Fee Structure

A flat fee structure is a user charge which is billed to each household periodically (monthly, quarterly, or annually). A flat fee is charged at a set rate regardless of the amount of trash collected. A flat fee benefits users which have a large amount of trash. A flat fee system typically does not benefit a user with minimum trash disposal needs. Many communities have adopted a flat fee structure.

B. Graduated Fee Structure

A graduated fee structure is a multi-tiered rate which charges a set amount for a certain amount of trash and a higher amount for larger volumes of trash. For example, the Town of Amherst charges users $105 a year for one 30-gallon barrel of trash per week and $140 per year for two 30-gallon barrels of trash per week. Thus, the larger volume user would pay more for larger volumes of trash.

C. Per Bag Fee Structure

A third fee structure charges on a per bag basis. Residents typically purchase special bags, or purchase special stickers or tags which are attached to trash bags. These specially marked bags are typically purchased at Town/City Hall, in stores throughout the community, or in the public works department. Proceeds from the sale of these bags defer solid waste costs. Trash collectors will only collect items which are contained in these bags. This type of fee structure encourages residents to recycle by producing less trash.

The Town of Webster currently charges residents $1.00 per bag at the municipal transfer station. The Town credits residents who bring in a container of recyclables $1.00 (in a coupon) for future use at the transfer station. Residents who do not participate in the recycling program, or bring in more than six bags for disposal are charged $2.00 per bag.

D. Sticker Fee Structure

Another fee structure is to charge residents a sticker fee for the use of the transfer station or landfill. A sticker fee is charged typically on an annual basis and provides the resident with access to the transfer station or the landfill. This fee structure can be combined with other fee structures, such as a per bag fee, to charge residents for the amount of trash disposed.

E. Card Punch Fee Structure

The card punch fee structure is a variation of the per bag system. Under this system, a resident would purchase a card with several numbers printed on the card. Each visit, the attendant punches out one number on the card. Variations of the system include the attendant punching a number for each bag disposed of at the landfill or transfer station. In any case, the card is purchased for a certain price.

VII. REVENUE PROJECTIONS

Once the rate design is selected by a community, the community should develop rates to recover total costs. To calculate rates, the community should include all direct, indirect, overhead and landfill closure and post closure reserve costs. An example is included in this manual as Appendix G.

In this example, $264,500 of collection costs, $122,388 of disposal costs, $91,417 of indirect and overhead costs and a $200,000 landfill closure and post closure reserve are included in the municipal landfill budget, for a total of $678,305 to be recovered from user charges (see Municipal Landfill Budget and Indirect and Overhead Cost Detail Worksheets). The fee structure utilized in this example includes fees from commercial dumping, residential dumping and residential curbside pickup. The residential dumping fees include a sticker fee and a dumping fee. Data utilized in this analysis include the following:

- Estimated commercial, industrial and apartment tonnage 950 tons

- Estimated residential curbside households 5,500 households

- Estimated residential stickers 400 stickers

- Estimated pounds of trash dumped 31,200 pounds

Commercial, industrial, and apartment user fees are set by the Town at $65.00 per ton dumped and the landfill sticker and dumping fees are established $10.00 and $3.25 respectively.

A Revenue Requirement Worksheet is then developed to analyze the amounts to be recovered through rates and to calculate the curbside pickup fee calculation. In this example, revenues to be recovered from commercial dumping equal $61,750. Residential dumping would produce $4,000 from sticker fees and $1,014 from dumping fees and an additional $611,541 to be recovered from 5,500 residential curbside pickups for an annual fee of $112.00.

Once the rates are computed, a Revenue Projection At New Rates Worksheet is used to verify that the new rates will produce the desired revenue. As shown on that worksheet, the aggregate of the commercial dumping revenue, curbside residential pickup and residential non-curbside fees produce $682,764, slightly more than the $678,305 to be recovered through rates.

VIII. WASTE REDUCTION INCENTIVES

When designing a user-fee program a community should decide what proportion of the cost of solid waste collection and disposal should be recovered through service charges. There are primarily two pricing methods which are used: 1) A one tier system where the price residents pay covers the total costs of refuse collection and disposal or, 2) a two-tier system where only the variable costs are covered by the price of the bag and the fixed costs are covered by general revenues.

Fixed costs represent:

> the actual cost for hauling household trash, curbside pickup -regardless of tonnage; or, in the case where curbside is not offered, the cost of hauling (tonnage) from a transfer station to the disposal point.
>
> the cost for hauling and disposal of municipal trash (school, town hall, etc.).

Variable costs represent:

> the cost for disposal of tonnage generated by household units.
>
> the cost of the bag or tag.

One-Tier System:

One of the points of the garbage fee is to present the true costs of solid waste collection and disposal to the producer of the garbage. If this goal is to be accomplished then the full cost of the solid waste service should be financed by the fee.

However, under this pricing scheme, the amount of revenue collected by a community will decrease as people act as expected and reduce the amount of waste they generate. This presents problems, because while some costs will decrease as the quantity of waste collected decreases (i.e. tipping fees at the landfill), other expenses will remain the same, independent of the level of waste generation and collection. In order for a community to recover these fixed costs, it will have to increase the fees as people reduce their amount of garbage or face a short-fall of revenue. Residents will not receive any sort of "reward" for trying to reduce the amount of waste the produce. This pricing structure therefore, does not provide proper incentives for residents of the community.

Two-Tiered System:

Preferably, a community should set the price of their bag or tag to cover the variable costs of solid waste collection and disposal. The fixed costs should then be funded separately either out of the general fund or through a split fee system. With the general fund subsidy, the residents may not face the total cost of solid waste services, and so may not reduce to the greatest degree possible. In either case, however, the incentive for waste reduction is evident through the cost per bag or tag system - the person producing four bags of trash pays four times as much as the person who produces one bag.

IX. IMPACT ANALYSIS

The decision by municipal officials to increase ISWM rates or to change to a new ISWM rate structure will have a direct impact on the users of the system. It is, therefore, important to analyze the impact of rate changes in order to provide local officials and decision makers with meaningful comparative information as they examine their rate options. The ISWM rate study should include impact analyses that demonstrate the impact of the change on specific customers.

This section of the manual will discuss various types of analyses that may be done to facilitate decision making:

- Impact of rate increase
- Impact of change in rate structure
- Comparison of the proposed rate to rates in other municipalities.

The impact of rate increases and of revised rate structures can be analyzed by:

- Comparison to other municipalities
- Average or "mean" waste
- The classification of users

A. Rate Comparisons

Municipal officials will determine ISWM rates and a rate structure based upon the community's intent and policy objectives. However, as part of the ratemaking process, local officials often desire to have information regarding ISWM rates and rate structures in other municipalities in order to provide additional perspective. To provide a comparative rate analysis one must complete the following steps:

- Determine the information to be compared
- Determine the comparative group
- Design a survey instrument
- Summarize and present survey results

For example, for a municipality that intends to maintain a flat rate structure it may be appropriate to:

- Compare the municipality's flat rate to other communities with a flat rate structure and consider the cost recovery policy of each municipality

- Compare only those municipalities that are in close geographic proximity

For a municipality that intends to change its rate structure (i.e., flat structure to graduated structure) it would be appropriate to:

- Compare the municipality's proposed graduated rates and structure to the rates and rate structure in other municipalities which have a graduating block structure.

- Compare the proposed rates to those municipality's that are similar in population or industrial mix.

The comparative information can be presented in a simple narrative, a table, or more visually in a graphic presentation.

CHAPTER 12 ACCOUNTING SUPPORT SYSTEMS

I. INTRODUCTION

Upon resolution of the cost recovery and rate structure policy issues discussed previously, local officials must select and implement an appropriate accounting support system. Each accounting alternative has specific guidelines and requirements, pursuant to Massachusetts General Laws. In addition, each has distinct advantages and disadvantages to a community, depending upon the community's financial and management policies and objectives. It should be emphasized that a community's decision as to which accounting support system to utilize should be predicated upon costing and rate policy considerations. The accounting system should support these policies, not dictate them.

Massachusetts communities must generally account by the Uniform Municipal Accounting System (UMAS) or statutory accounting system. Generally, both methodologies require the use of funds and account groups, and both will technically support the integrated solid waste management (ISWM) principles discussed later in this chapter. The Massachusetts Division of Local Services of the Department of Revenue is responsible for the Commonwealth's accounting guidelines and procedures. These guidelines and procedures are documented in the Commonwealth's UMAS manual and the Functions of General Ledger Accounts, for statutory accounting.

To account for integrated solid waste management, a community may utilize one of three fund accounting alternatives. These alternatives are:

- General Fund

- Special Revenue Fund

- Enterprise Fund

The remainder of this chapter discusses policy issues which must be addressed in selecting an accounting system from the above three alternatives, ISWM principles and the features of each specific accounting alternative.

II. POLICY CONSIDERATIONS

In deciding which accounting support system to use, two major considerations should be addressed by local officials. These considerations are:

- Segregation of ISWM costs and revenues

- Surplus retention.

Each of these issues is discussed below.

A. Segregation of ISWM Costs and Revenues

Local officials may wish to segregate ISWM costs and revenues from other municipal costs and revenues. Generally, the segregation of utility costs and revenues offers several advantages to a community by periodically providing detailed information to:

- Facilitate rate analysis and rate setting
- Facilitate analysis of total cost and cost recovery
- Enhance overall decision-making
- Provide public disclosure to taxpayers and ratepayers

Should a community choose to make this segregation, it must utilize either a special revenue fund or an enterprise fund for ISWM accounting. Both special revenue funds and enterprise funds provide for the segregation of ISWM costs and revenues in distinct funds, separate from other community finances.

Alternatively, if ISWM operations are accounted for in the community's general fund, these costs and revenues will be commingled with other financial transactions in this fund. The ISWM financial activity would still exist on the community's books, but would not be "broken out" separately. Accordingly, information as to the financial status of ISWM operations is not accounted for nor reported as a single entity in the general fund; this information must be identified and compiled when desired.

As discussed earlier, the recovery of full costs through ISWM revenues is a policy issue made apart from the selection of an accounting support system. Full cost recovery through rates is not required for any of the accounting options. However, for those communities which adopt a full cost recovery policy, both enterprise funds and special revenue funds support that policy through the segregation of ISWM costs and revenues from other community finances. Accordingly, these two accounting alternatives provide the expenditure and revenue information to facilitate the attainment of full cost recovery. Alternatively, under the general fund option, this information is available but not segregated and not easily compiled.

B. Surplus Retention

A second decision which must be made by local officials relates to the retention of any surplus that may be generated in a particular fiscal year from ISWM operations. A surplus is defined as the excess of ISWM revenues over ISWM expenditures within a given fiscal year. If a community expects to have (or has) a surplus from ISWM operations, does the community wish to retain the surplus separate from other community funds for future ISWM operations? As more communities move toward "self-sustaining" ISWM operations, and provide a "landfill closure and post closure reserve," this issue takes on increased importance. Should local officials decide that their objective is to retain a surplus for future utility operations, certain accounting options exist. Pursuant to Massachusetts General Laws, the community may adopt a special revenue revolving fund or an enterprise fund to attain this surplus retention objective.

III. MASSACHUSETTS ACCOUNTING

Accounting support systems for ISWM operations described in this chapter relate directly to Generally Accepted Accounting Principles (GAAP) and the Commonwealth's Uniform Municipal Accounting System (UMAS) and statutory accounting system. This section provides a brief discussion of accounting for ISWM operations in Massachusetts. Both UMAS and statutory accounting systems are presently utilized by Massachusetts communities. Both require that the municipality's financial transactions be accounted for within fund(s) and account group(s). A fund is defined as:

> "a fiscal and accounting entity with a self-balancing set of accounts recording cost and other financial resources, together with all related liabilities and residual equities or balances and changes therein, which are segregated for the purpose of carrying on specific activities or attaining certain objectives in accordance with special regulations, restrictions, or limitations."

An account group is defined as an entity which is:

> "used to establish accounting control and accountability for the government's general fixed assets and the unmatured principal of its general long-term debt including special assessment debt for which the government is obligated in some manner."

Accordingly, regardless of whether a community utilizes a UMAS or statutory accounting system, ISWM accounting is essentially the same in that (a single or multiple) funds must be utilized. Under the general or special revenue fund options, ISWM activity may be accounted for in more than one fund, depending upon the nature of the activity. For example, capital projects would be accounted for in a Capital Projects Fund (UMAS) or Non-Revenue (statutory). Under an enterprise fund, however, all ISWM activity should be accounted for within that single fund. The following funds and account groups may be utilized by a community to account for particular aspects of ISWM operations.

- General Fund - to account for all financial resources except those required to be accounted for in another fund.

- Special Revenue Funds - to account for the proceeds of specific revenue sources (other than expendable trusts or for major capital projects) that are legally restricted to expenditure for specified purposes.

- Capital Projects Funds - to account for financial resources to be used for the acquisition or construction of major capital facilities (other than those financed by Proprietary (enterprise) funds and Trust Funds).

- Enterprise Funds - to account for operations:

- Financed and operated in a manner similar to private business enterprises where the intent of the governing body is that the costs (expenses, including depreciation) of providing goods or services to the general public on a continuing basis be financed or recovered primarily through user charges; or

- Where the governing body has decided that periodic determination of revenues earned, expenses incurred, and/or net income is appropriate for capital maintenance, public policy, management control, accountability or other purposes.

- Trust and Agency Funds - to account for assets held by the governmental unit in a trustee capacity or as an agent for individuals, private organizations, other governmental units, and/or other funds. These include a) expendable trust funds, b) nonexpendable trust funds, c) pension trust funds and d) agency funds.

- General Fixed Assets Account Group - Fixed assets related to specific proprietary (enterprise) or nonexpendable trust funds should be accounted for in those funds. All other fixed assets should be accounted for in this account group.

- General Long-Term Debt Account Group - General long-term liabilities of proprietary (enterprise) funds or Nonexpendable Trust Funds should be accounted for in those funds. All other unmatured long-term liabilities should be accounted for in this account group.

Specific procedures as they relate to the above fund types and Massachusetts municipal accounting in general are contained in the Commonwealth's UMAS manual and statutory accounting guide.

As previously discussed, the general fund, special revenue fund and enterprise fund represent the three specific options for communities to account for their

ISWM operations.

Selection of special revenue or enterprise funds by a community requires adoption of appropriate legislation and the utilization of accounting procedures. Pursuant to Massachusetts General Laws, relevant accounting statues are the following:

- Section 53F1/2 of Chapter 44- allows a community to establish an enterprise fund for ISWM operation. The community must adopt Chapter 44, Section 53F 1/2 and apply this statute for ISWM operations.

- Section 53E 1/2 of Chapter 44 - allows communities to establish an ISWM revolving fund which is classified as a special revenue fund. The community must adopt Chapter 44, Section 53E 1/2 to establish a revolving fund and be authorized annually.

Local officials are encouraged to discuss these legal and accounting options with legal counsel and the Town Accountant or City Auditor/Comptroller.

IV. ISWM ACCOUNTING ALTERNATIVES

This section describes the characteristics, advantages and disadvantages of each accounting support system alternative. Advantages and disadvantages are presented from the perspective of a community which presently accounts for ISWM operations in the general fund. These issues should be carefully considered by local officials in light of relevant costing and rate policy determinations. The key accounting consideration should be the degree to which an accounting system supports the community's cost-recovery and ISWM financing objectives.

A. General Fund

General fund accounting for ISWM operations is generally the most understood accounting support alternative. This option does not require adoption of any legislation. Essentially, ISWM expenditure and revenue accounts exist with the general fund along with other community activity. No segregation of utility costs and revenues is provided for. General fund accounting is on the budgetary (cash) basis and period-end or year end reporting is on the modified accrual basis.

Certain advantages and disadvantages exist for communities to consider regarding this alternative, as outlined below.

Advantages:

- Requires no change; communities need not train staff and can continue their current accounting and financial reporting practices.

- Does not require establishing separate funds within the accounting system.

- Does not require fixed asset inventory or valuation, as is required for enterprise fund accrual reporting.

Disadvantages

- More difficult to analyze utility financial data in a timely and ongoing manner because that information is not segregated.
- Difficult to identify the general tax "subsidy" to ISWM operations.

- More difficult to determine fair and equitable rates to charge users/rate payers.

- Does not provide closing and post closure reserves (unless funded through receipts reserved for appropriation). In summary, the general fund alternative for ISWM operations is the least directly expensive option which must be carefully considered by local officials in light of clear information-related disadvantages.

B. General Fund Accounting Procedures

Budgets

- Provide ISWM budgets as part of the municipal budget
- Should have fully loaded budget for expenditures and revenues for costing, pricing and rate setting but no formal "fully loaded" presentation is required.

Accounting

- Budgetary (cash) basis
- Combined with other departmental expenditures and receipts
- Deficits or surpluses for ISWM buried in the general fund
- Capital projects are accounted for in the capital projects fund with bonds accounted for in the general long-term debt account group
- Fixed assets should be accounted for in the general fixed assets account group.

C. Special Revenue Fund

Special revenue funds represent a second alternative for a community's ISWM accounting. A special revenue fund is defined as "a fund used to account for the proceeds of specific revenue sources (other than expendable trusts or major capital projects) that are legally restricted to expenditure for specified purposes". In Massachusetts, a departmental revolving fund may be established for ISWM under Chapter 44, Section 53E 1/2, and must be approved annually. In a town, a ISWM revolving fund must be authorized by a majority vote of an annual town meeting upon the recommendation of the Board of Selectmen. In a city, an annual vote prior to the start of a fiscal year by the City Council upon the recommendation of the mayor or city manager is required. An authorization makes the approved ISWM revolving fund effective for the ensuing year only and must be reauthorized annually. The authorization vote must specify:

- The ISWM receipts that are to be credited to the fund
- The purpose for which the monies are to be spent
- The Board, department or officer authorized to spend monies from the fund
- A dollar limit on the amount that may be spent from the fund in the ensuing fiscal year. During the course of a fiscal year, this original amount may be increased in a town by vote of the selectmen with the approval of the finance committee or in a city by vote of city council with approval of the mayor or city manager. During the fiscal year, only the dollar amount may be increased, not the general scope nor

spending purposes, nor may the total amount be exceeded. The total spending amount for the ISWM revolving fund or any fund established under Chapter 44, Section 53E 1/2 is limited to one (1) percent of the amount of the most recently approved tax levy. Further, the total spending amount for all revolving funds established under Chapter 44, Section 53E 1/2, including the ISWM revolving fund, may not exceed 10% of the most recently established tax levy. In addition, the municipal revolving fund statute restricts a community from charging salaries and wages for full-time employees to the fund. Thus, if full-time salary personnel operate the solid waste facility, this accounting option does not exist. Special revenue fund accounting provides for segregation of ISWM costs and revenues from other municipal financial activity. Like the general fund, special revenue fund accounting is on the budgetary (cash) basis and financial reporting is on the modified accrual basis. Advantages and disadvantages of the special revenue fund for ISWM are summarized below.

Advantages:

- Segregates utility's inflows and outflows within one fund

- Provides better information for management decision-making

- Does not require inventory, valuation of fixed assets or maintenance of fixed asset inventory for fund accounting

- Does not alter the annual budget preparation, approval and execution process

- Does not require a change in administrative/legislative authority

- Surplus at fiscal year end does not revert to general fund; surplus may be used by the utility for operations or to reduce subsequent years' ISWM rates, provided that the fund is reauthorized annually.

Disadvantages:

- Salaries and wages of full-time municipal employees cannot be charged to the fund.

- Requires establishing a separate fund

- Requires training of accounting office staff

- Interest is not credited to the fund

- Must be reauthorized annually

- Contains important spending limitations

- Capital projects and long-term debt are accounted for elsewhere

- Does not provide reserves for landfill closure or post closure costs without receipts reserved for appropriations for such purposes.

D. Special Revenue Fund Accounting Procedures

- Adopted Chapter 44, Section 53E1/2, which classifies ISWM as special revenue funds

- Segregates ISWM into a separate fund apart from the general fund

- ISWM operations and maintenance costs are accounted for in this fund

- Capital outlays (equipment) are also accounted for in this fund if sufficient revenues exist to pay for these outlays

- Capital projects are accounted for in the capital projects fund with bonds accounted for in the long-term debt account group

- Fixed assets should be accounted for in the general fixed assets account group

- Provide ISWM revenue and expenditure budgets as part of the municipal budget process

- Should have "fully loaded" budget for expenditures and revenues for costing, pricing and rate setting but no formal "fully loaded" presentation is required

- Accounting is on the budgetary (cash) basis

- Financial statement reporting is on the modified accrual basis

E. Enterprise Fund

Enterprise funds represent the third alternative for communities to account for their ISWM operations. Enterprise fund accounting is relatively new to the Commonwealth and, as such, many communities are still early in the implementation process.

An enterprise fund is defined as:

- A fund established to account for operations financed and operated in a manner similar to private business enterprises. In this instance the governing body intends that costs (expenses, including depreciation) of providing goods or services to the general public on a continuing basis be recovered primarily through user charges, or

- A fund established because the governing body has decided that periodic determination of revenues earned, expenses incurred and/or net income is appropriate for capital maintenance, public policy management control, accountability or other purposes.

Like special revenue funds, enterprise funds allow communities to separately account for the expenditures and revenues of their ISWM operations. Similarly, this segregated accounting provides enhanced information regarding the results of operations and facilitates rate setting and rate analyses. A community may elect to adopt an enterprise fund through city council or town meeting vote.

Enterprise fund accounting is generally the most complex of the accounting alternatives. Its accounting may be on the accrual basis or budgetary (cash) basis. Reporting, however, should be on the accrual basis. Accordingly, if accounting is on the budgetary basis, year-end accrual adjustments will be required to attain accrual basis reporting. These year-end accrual adjustments will generally include:

- Fixed asset capitalization and related depreciation

- Pension liabilities

- Sick, vacation, and other compensated absences

- Revenue

- Other year-end accruals

A significant difference between enterprise fund and other accounting alternatives is its requirement for fixed assets accounting. Generally, utilities have a significant investment in plant, buildings, machinery, infrastructure and other fixed assets. Accordingly, GAAP requires the accounting for enterprise fixed assets to enhance the community's control, accountability, and management information and to provide for total costs, including depreciation. Fixed assets are discussed in more detail later in this section.

A number of distinct advantages and disadvantages exist for this accounting alternative, which should be carefully considered by local officials. They are outlined below.

Advantages:

- Segregates utility inflows and outflows to facilitate analysis of cost recovery

- Provides comprehensive information for management decision making

- Does not require a change in administrative/legislative authority

- Does not alter the annual budget preparation, approval and execution process

- Provides for a reserve for landfill closure and post closure costs

- Salaries and wages of full-time employees are an allowable cost of the fund

- Allows for level debt payment

- Does not need to be reauthorized annually

- Is not restricted to a percent of the tax levy

- Does not require total cost recovery; accounting is separate from rate-setting

- Surplus at fiscal year end does not revert to general fund; retained for utility operations subject to appropriations or to reduce subsequent year rate increases

- Credits interest earnings to the fund

Disadvantages

- Requires establishing a separate fund

- Requires additional effort to develop a total expenditure and revenue budget

- Requires commitment of resources to establish and maintain a fixed assets accounting system

- Generally requires training for accounting office staff to implement

- Requires an accounting system which can demonstrate compliance with both accrual reporting and budgetary basis of accounting pursuant to GAAP and Massachusetts General Laws Communities may wish to consider adopting the legal enterprise fund (Chapter 44, Section 53F1/2) and operating utility activity on a budgetary basis with modified accrual adjusting entries (as if the entity is a special revenue fund) until such time as the community is able to provide full accrual information. This consideration has several advantages, as listed below.

- Provides one legal statute to be adopted (Chapter 44, Section 53F1/2) for several utility operations (i.e., water, sewer, ISWM) thus eliminating confusion regarding alternative options

- Provides one accounting treatment for several utility operations, thus providing consistency between funds

- Allows communities time to develop accrual based data while providing the above advantages While the three options described in this section are available to communities for ISWM budgeting and accounting purposes, the Division of Local Services and the MDEP encourage the use of enterprise funds to properly support ISWM operations. To fully implement enterprise fund accounting, communities would be required to take the following steps:

- Adopt Chapter 44, Section 53E1/2, an act to authorize enterprise funds

- Apply the provisions of Chapter 44, Section 53F1/2, to ISWM operations

- Prepare a fully loaded, total expenditure and revenue budget for ISWM operations as a separate but integral part of a community's budget

- Account for utility operations on a budgetary (cash) basis

- Develop accrual based financial data

- Develop a fixed assets accounting system

F. Fixed Assets Accounting

GAAP requires that municipalities account for general fixed assets in the General Fixed Assets Account Group. Enterprise fund related (ISWM) fixed assets are required to be accounted for in the enterprise fund. Because this generally represents a major difference from the other accounting options in Massachusetts, local officials should carefully consider the costs and benefits involved in light of community objectives. Communities should have a fixed assets accounting system for accountability, control and management decision making regardless of whether or not the community has an enterprise fund. Basically, the benefits of having ongoing fixed assets information (i.e. data on age, cost, etc. of plant, equipment, vehicles, and the like) must be compared to the cost of establishing and maintaining a fixed assets system. In Massachusetts, communities are required to account for fixed assets as of the date of inception of the enterprise fund. Communities are also encouraged to account for utility based assets prior to the establishment of the enterprise fund. A fixed asset is defined as an item of property with a:

- Tangible nature

- Significant value (significance of value is a matter of judgment by local officials; a policy addressing this criterion should be established up front in a capitalization policy by the community)

Fixed assets are generally categorized as follows:

- Land
- Building
- Machinery and equipment
- Infrastructure
- Construction-in-progress

Fixed assets systems allow the processing and ongoing maintenance and control of fixed assets information. This typically entails establishing a fixed assets data base and corresponding procedures and controls to both maintain the data base and reconcile the data base to community accounting records. Establishing and implementing a fixed assets system requires varying levels of effort and cost depending upon the size and sophistication of the community, and the age, size, and complexity of the utility operations. Most of the actual costs incurred are one-time, startup costs. Generally, once the decision is made to institute fixed assets accounting, the following implementation steps must be taken:

- Establish fixed asset policies
- Design the system, including records and procedures
- Inventory and tag existing assets
- Value the fixed assets
- Process fixed assets information
- Maintain the system pursuant to established policy and procedures.

V. ENTERPRISE FUND ACCOUNTING PROCEDURES

A. Introduction

- Adopt Chapter 44, Section 53F1/2
- Apply the provisions of Chapter 44, Section 53F1/2 to ISWM
- Establish a separate accounting fund for ISWM fund into which all receipts and disbursements and all assets, liabilities and retained earnings are accounted for
- Fixed assets and long-term debt are accounted for in the enterprise fund
- An enterprise fund is an accounting methodology which identifies total costs for pricing and cost recovery considerations and is not a rate setting mechanism

B. Budgets

- Revenue and expenditure budgets shall be submitted as a separate but an integral part of the community budget to the executive who shall submit the budget to the appropriating authority
- Estimated income in excess of total anticipated expenditures is

appropriated to a special budgetary reserve fund for subsequent appropriation by the appropriating authority

- Budgetary deficits will be financed by an operating subsidy from the general fund and included in the tax rate computation

- Budgets should include all direct and indirect costs including overhead costs for a total "fully loaded" expenditure budget and a total revenue budget

Direct costs include:

- Personnel Services
- Purchase of Services
- Supplies
- Assessments
- Debt Service
- Other Charges and Expenditures
- Capital Outlay

Indirect costs are allocable costs and include:

- Insurances
- Pension Costs
- Other Fringe Benefits
- Overhead Costs
- Other Allocable Costs

- Overhead costs include indirect costs for the Town Accountant, Treasurer, Collector, Data Processing, Purchasing Departments and the like allocable to ISWM operations

- Indirect costs including overhead costs are to be appropriated in the general fund and transferred to the ISWM fund as an expenditure transfer

- Budgets should include a landfill closure and post closure reserve, if applicable

- Direct costs shall be appropriated in the ISWM fund

- Indirect (including overhead costs) transfers are to be based on the budget

C. Accounting

- Budgetary (cash) basis

- Legislation allows other accounting basis (modified accrual or accrual). Communities are encouraged to utilize the budgetary (cash) basis before considering an alternate basis. The accounting system must be on the same basis as the budget

- A separate checking account is not required for ISWM. A separate accounting for enterprise receipts and disbursements is required

- Actual year-end surplus is calculated on a modified accrual basis and is closed to retained earnings and may be appropriated as available funds once certified by Department of Revenue

- Any actual deficit is provided for in the subsequent year

- Fixed assets are required for Massachusetts, communities are required to account for fixed assets acquired on or after the date of inception of the enterprise fund

- Communities are encouraged to have a full accounting of fixed assets

- Communities are encouraged to adopt Chapter 44, Section 53F1/2 even if accrual information is not available. Communities will be allowed a reasonable period of time to develop accrual information. In the interim a community can adopt enterprise funds (called a "budgetary enterprise fund") and operate these funds as if they are special revenue funds until the community develops full accrual information

- Enterprise fund "free cash" shall be termed "certified available funds."

D. Reporting

- Accrual basis of reporting for financial statements

- Different options of reporting enterprise funds are available to communities. Specific issues include fixed assets accounting depreciation, pension expense and the like Communities are encouraged to discuss these financial reporting options with their independent auditors

- Schedule A-2 of the Tax Recap Sheet should be completed for the enterprise fund

- Report as enterprise funds on Schedule A (modified accrual or accrual)

VI. ACCOUNTING FOR LANDFILL CLOSURE AND POST CLOSURE COSTS

At the time of the writing of this manual, the Government Accounting Standards Board (GASB) is currently completing a review of a proposed Statement that would require municipal governments that own solid waste landfills subject to federal, state, or local closure requirements to recognize a portion of future closure and post closure care costs as landfill closure liabilities in each fiscal year that the landfill accepts solid waste. The Exposure Draft (ED), Accounting For Solid Waste Landfill Closure And Post Closure Care Costs is being issued by the GASB in response to the October 9, 1991 Environmental Protection Agency Rule "Solid Waste Disposal Facility Criteria," which establishes guidelines for closure and 30-year post closure care requirements for all municipal solid waste landfills that receive waste after October 9, 1993. In this ruling, EPA has made state governments responsible for implementation and enforcement of the new rule.

The EPA ruling requires municipalities that own a solid waste landfill to perform certain closing functions and post closure monitoring functions as a condition for the right to operate the landfill in the current period. Certain costs of meeting the EPA rule and local or state laws or regulations will be paid by the municipality during the operation of a solid waste landfill. Other requirements, however, for closure and post closure care will result in cash payments only when the landfill is closed. The EPA rule provides that when a landfill stops accepting waste (after October 9, 1993) it must provide for a cover with a minimum of twenty-four (24) inches of earth to keep liquid away from the buried waste. Once the landfill is closed, the owner is responsible for post closure activities to maintain for a thirty year period the:

- Final Cover

- Monitoring Ground Water and Methane Gas
- Collecting and Treating Leachate.

Accordingly, municipalities that own a solid waste landfill that is subject to these provisions must recognize a portion of the estimated total landfill closure and post closure care costs in each fiscal year. This recognition is based on the percentage of estimated total landfill capacity used that fiscal year. Estimated total costs, as defined by the GASB, consists of three components:

- The cost of equipment and facilities used in post closure monitoring and care
- The cost of final cover
- The cost of monitoring the landfill during the post closure period

The GASB also encourages communities to include the costs of environmental clean-up after closure. Estimated total cost would be calculated on the cost to purchase those services and equipment currently (current dollars) and would be required to be updated on an annual basis. If these estimates change, they would be reported prospectively in the current and future periods. Disclosure of total estimated costs remaining to be recognized, the amount reported to date as landfill expenditure/expense, the method of financing the post closure liability, the market value of investments, and remaining landfill capacity and life would be required.

A. Applicability

The Exposure Draft would be applied retroactively for financial statements for periods ending after June 15, 1993. The GASB is encouraging earlier application. For periods beginning before June 15, 1994, landfills that are reported in governmental fund types (general or special revenue funds) would report landfill closure expenditures based on this method to the extent that they normally would be paid with expendable available financial resources. Remaining amounts would be reported in the general long-term debt account group. The GASB plans to issue a future pronouncement which will provide guidance on reporting in governmental fund types for periods beginning after June 15, 1994. For enterprise funds, the EPA rule would require a community to accrue annually the liability for closure costs if the community has accepted waste after October, 1991. The amount of the liability to be accrued has not been defined by EPA. EPA has delegated the determination of reportable expense to the states. Post closure expense would be accrued if a community accepts waste after October, 1993.

B. Landfill Closure and Post Closure Reserve

Many Massachusetts municipalities are facing significant landfill closure and post closure costs in the future, particularly if the municipal solid waste landfill accepts waste after October 1, 1993 and are subject to the above EPA rule. Massachusetts General Laws, Chapter 44, Section 28(c) (f) requires that communities set aside funds for the estimated cost of closing any existing operating solid waste facility. This section also requires communities to clean up or prevent pollution caused by inactive landfills. Accordingly, communities should build into their user fees an amount for a landfill closure and post closure reserve that will build up over several years to minimize the impact of rate shock by providing for full landfill closure and post closures costs in future periods. Accordingly, the municipality must consider an accounting support system capable of providing a landfill closure reserve to accommodate this build-up. The enterprise fund is recommended to account for an active landfill or transfer station operated by the Town and to account for a landfill closing and post closure reserve. To establish a landfill closure and post closure reserve, the community provides for the reserve amount through the rate setting process. At the end of the accounting period, the Town Accountant/City Auditor would prepare a journal entry reducing the undesignated retained earnings and establishing or increasing a reserve for landfill closure and post closure within retained earnings.

If the community is accounting for integrated solid waste management under the general fund or the special revenue revolving fund, the community may establish a landfill closure and post closure reserve as a receipt reserved for appropriation by appropriating funds for this purpose.

COMBINED USER FEES AND SEGREGATED ACCOUNTING

Communities should consider self-sustaining user fees to support municipal integrated solid waste management objectives and establishing a segregated fund (special revenue or enterprise fund) to account for ISWM. The advantages and disadvantages of the special revenue and enterprise fund have been discussed previously in this chapter. There are significant advantages to establish a segregated fund if the community's objective is to provide integrated solid waste management on a self-sustaining basis. By establishing a "fully-loaded budget" and by maintaining a segregated fund, the municipality can track periodically the results of operations during the year through budget and actual reporting. Special revenue or enterprise fund accounting combined with self-sustaining user fees present the community with a powerful fiscal management tool to meet the community's integrated solid waste management needs.

CHAPTER 13 PROCURING CONTRACTING SERVICE

I. INTRODUCTION

A major step for a municipality in assessing and/or closing a sanitary landfill is the contracting process. Contracting activities; establishing an oversight committee, appropriating funds, interviewing and hiring a consultant, and the actual project oversight, make up the municipal role in the process. Part II of this Chapter presents general contracting guidelines and will focus on these activities.

Part III and IV of this Chapter discusses the State's procurement regulations, Chapter 30B, as they affect landfill assessment and closure, and provides a summary of requirements as put forth by the Office of the Inspector General. While 30B is not required to be followed explicitly for landfill assessment and closure activities, the regulations provide a framework from which to conduct contracting activities.

Appendix E presents a model RFP which can be used for contracting assessment and closure consulting services. It is also available on diskette from the Department.

II. GENERAL CONTRACTING CONSIDERATIONS

A. Pre-RFP Considerations

1. Use of In-House Expertise

Prior to development of a Request for Proposals, the municipal assessment and closure coordinator should determine how much, if any of the work can be done by in-house staff. Much of the initial site assessment activities consist of report and record gathering, and determining historic use of the landfill. This may be competently done by local committee or board members. Additionally, engineering and public works staff can be responsible for certain design and construction activities.

To determine the potential for using local staff, one should look at staff expertise, whether the required staff (or volunteers) could commit the required time, and whether local staff could meet tight scheduling deadlines. A final consideration is whether outside personnel are needed for political reasons.

2. Pre or Post-Funding

A second set of decisions involve whether the RFP process should begin before or after funds have been allocated. Generally it is better to wait until funds have been appropriated to advertise for proposals. Unfunded proposals will draw a limited number of responses due to the uncertainty of the project going forward.

Although obtaining bids prior to allocation of funding provides a more accurate idea of the funding amount needed to finance the project, it generally results in smaller group of firms responding to the bid request. This is understandable as the consultant is not assured that the project will go forward should they be selected to do the work.

As an alternative, a community can issue a request for qualifications which would provide information on potential contractors and some general pricing guidelines without requiring them to spend the amount of time needed to package a full proposal. Costs estimates are also generally available from the Department and are discussed in Chapter 13. General estimates should be sufficient to use for the appropriation process. In this case following appropriation of funds, a more detailed RFP process can be completed and sent out for bid proposals.

B. The RFP Process

Like any major purchase, it takes research and repetition to gain the necessary expertise to make a wise purchase. As a new home buyer would pay an inspector to check out a home before purchase, the committee should consider using an "inspector" to evaluate the proposals submitted by consultants and subsequent agreements. An individual within the municipality with expertise in contracting services, or an outside consultant in this field can provide this expertise. Publications such as those listed in the reference section can also provide helpful tips on structuring the RFP, interviewing and structuring an agreement. The community's legal counsel will play an important role in structuring and/or reviewing the final contractual document.

1. The RFP

The RFP should include:
- A description of services needed - including technical details;
- the amount budgeted for the proposal;
- The type of people required for the project;
- Criteria by which the proposals will be screened and evaluated;
- Proposed schedule for the project;
- Format requirements;
- How the consultant will be selected.

A pre-proposal meeting can be used to clarify the activities which need to be done.

2. RFP Review

Things to be considered when reviewing submitted proposals:

- Be more concerned with the Staff that will be working on the project, than the size and qualifications of the firm;
- Request that the project manager make or be present at the presentation and that key staff are also present;
- Know what activities need to be completed, and what expertise is needed to complete them;
- Develop a rating sheet which can be used during the interview process.

3. Contracting Considerations

Things to be considered when structuring the subsequent contract:

- Develop a detailed scope of work;
- Work together on a schedule;
- Spell out who will do what work - including activities by the local board and engineers;
- Designate project manager for the firm;
- Designate a municipal person in charge;
- Method of Compensation;
- Information sharing provisions - how information will be reported;
- Number of Meetings between Town, (the DEP) and Consultant;
- Limitations on changes and staffing.

It is important that schedule and milestones be worked out jointly by committee and consultant. In addition it is useful to make DEP staff aware of the schedule. The committee has a responsibility to have a good grasp of what is required of the consultant, and to formulate the RFP and subsequent contract around these requirements. The Department of Environmental Protection's guidelines for assessment activities included in the appendix, and the technical chapters of the manual can be used to outline the tasks which need to be completed.

The relationship established between the consultant and the Town is also critical. The committee's role is to keep the consultant updated on the local politics as they affect the project. The role is reversed on technical matters.

4. Potential Problems

A problems that occurs frequently in working with consultants is changes in staff from experienced to less experienced personnel. This can be avoided to some degree by designating contractual lead personnel and their backup. It is also helpful to request that lead personnel participate in RFP interviews. A second problem is the submission of canned reports. This is not necessarily a problem, however, the cost of these reports should represent the fact they are pre-packaged.

Problems which have the potential to slow the assessment activities down include: working from pre-existing contracts or making mid-assessment contract alterations; finding and using existing or pre-existing work; sites which are in litigation; trying to address problems within impossible time frame; and, lack of coordination within the municipality.

III. THE ROLE OF CHAPTER 30B

Since it was promulgated in May of 1990, there has been much anxiety and concern over the effect of Chapter 30B, the State's Uniform Procurement Act. Seeing the potential disruption in procuring services for assessment, this section was included to assist communities in working within the 30B framework.

The Office of the Inspector General published a document titled, Municipal, County, District, and Local Authority Procurement of Supplies, Services and Real Property in March of 1990, to provide guidance to municipalities and public authorities in contracting for among other things, professional services. This section details design services which must be contracted for pursuant to Chapter 30B. Under Chapter 30B landfills are exempt from the stringent contracting procedures. A footnote within the exemption section specifically lists landfills as public works projects exempt from the process. However, the note recommends that the procedures still be followed when procuring services.

The Department recommends that municipalities follow the procedure to the extent possible with an understanding that they will not be held liable for not adhering to the regulations. The recommendation is made because the procedures provide a well-defined approach to establish, evaluate, and document contracting activities. The approach is particularly beneficial in that it places emphasis on criteria-based selection as opposed to solely a price-based selection.

A. Chapter 30B Requirements

This section is not meant to serve as a replacement for the above mentioned document prepared by the Office of the Inspector General. Its intention is to provide an overview of the 30B requirements applicable to this RFP.

B. 30B Defined

Chapter 30B is a set of regulations governing procurement for local governments in Massachusetts. It establishes comprehensive guidelines governing public contracts for supplies, equipment, service and real estate. Its intentions are as follows:

- To simplify, clarify and modernize the laws governing procurement by municipalities, districts, and local authorities;
- To make procurement laws consistent;
- To ensure fairness and equitable treatment of all persons who provide services and supplies;
- To provide economies of scale and to maximize the purchasing value of public funds;
- To create effective competition;
- To provide quality and integrity within the procurement system.

30B maintains uniform procedures for the awarding of government contracts. It also clarifies the rules for modifying, amending and renewing agreements and exercising options under contracts.

C. Contracts for Supplies and Services

The majority of agreements between local governments and private vendors are covered by 30B. It also applies to agreements to provide supplies or services to a jurisdiction regardless of whether the jurisdiction is responsible for the actual payment to the contractor.

Within 30B, supplies and services both have clear, distinct definitions.

> Supplies - "Supplies" refers to all property other than real property, including materials, equipment, printing, insurance, and services incidental to the conveyance and installation of such property.
>
> Services - "Services" refers to the furnishing of labor, time, or effort by a contractor, not involving the furnishing of a specific end product other than a report.

However, the definition of services does not include employment arrangements, collective bargaining or grant agreements. Seventeen (17) types of services and/or agreements are exempt from 30B. The Exclusions relevant to this RFP are briefly described as below: (note: see pp. 23-25 of the procurement manual for appropriate guidelines)

- Contracts for construction work and for the purchase of construction materials;
- Contracts for design services for building projects, subject to the Designer Selection Law;
- Intergovernmental agreements entered into by two or more local government units;
- Transactions with the Commonwealth;
- Contracts to purchase materials at prices established by the State's Department of Public Works through competitive bidding for highway or road construction;
- Agreements between agencies, boards, commissions, authorities, departments, or public instrumentalities of one city or town;
- Contracts to purchase supplies or services from the Federal government, the Commonwealth, or any of its political subdivisions;

- Contracts for governmental unit insurance pools;
- Contracts for some professional services;
- Purchases made pursuant to a blanket contract awarded to a vendor by the Commonwealth.

D. Contract Amendments

The quantity of supplies or services called for in the contract cannot be increased by more than ten (10) percent under an existing contract. If more than this amount is required after the initial contract has been awarded, the municipality, county or local authority must re-advertize and award a new contract for the additional supplies or services. Extra work orders exceeding ten percent of the original contract will not be approved unless this guideline is followed. Gasoline, fuel oil and road salt are the only exceptions.

30B also contains requirements for quantity increases in contracts: the unit price of the additional supplies or services must be the same or less than the original contract price; the procurement officer must determine in writing that the increase is necessary and, more practical and economical than awarding a new contract; and both parties must agree to the increase in writing.

E. Record Keeping Requirements

All written documents required under 30B must be maintained for a period of six years from the date of the final payment of the contract and must be available for public inspection (except for proposals submitted by offerers which shall remain confidential until the completion of the evaluation).

For agreements from $1000 - 10,000, written records which include the purchase specifications, the names and addresses of all persons from whom quotations were sought and the date and amount of each quotation must be kept.

For agreement from $5000 or more, there must be a file for each contract which contains all required written documents, including the executed contract and any amendments to the contract.

F. Enforcement Provisions

30B prohibits bid-splitting: ie, the splitting or dividing of any procurement for the purpose of evading the legal requirements of 30B. Two enforcement provisions exist which ensure that contracts are awarded in compliance with the law:
1) No payment can be made under an invalid agreement.
2) Civil penalties can be imposed for violations of Chapter 30B.

IV. CONCLUSIONS

The Request for Proposals forms the basis of the contractual agreement between the municipality and the selected consultant. It is important for the municipality to take an active role throughout the process. The municipal committee involved in overseeing the assessment and closure activities should have a working understanding of tasks which will be conducted, and products which will be delivered.

Documentation of activities is critical both to support decisions which have become part of the assessment and/or closure contract, and for referencing the reasoning behind selected actions over the long time-frame in which the work will be performed.

CHAPTER 14 PLANNING AND MANAGING LANDFILL ASSESSMENTS AND CLOSURES

I. INTRODUCTION

When conducting a landfill assessment and subsequent closure there are ongoing planning and management activities which a municipality must go through in order to assure a successful outcome. These activities can consume large amounts of volunteer and staff time working with town officials and citizenry, DEP's Division of Solid Waste Management, and the consulting firm contracted to do the required work. Generally speaking, a municipality which works effectively in meeting its responsibilities will see better results and will often save money over the project life.

This chapter will focus on two areas: 1) Working with a community and its local officials; and 2) Landfill assessment and clean-up planning and scheduling. This chapter should be particularly useful to local officials and volunteers who will be undertaking their first major municipal project.

II. WORKING WITH LOCAL GOVERNMENT

A. Municipal structure

The structure of a municipality will depend on its size and affluence. Towns with large populations and large tax revenues to draw from will have professional staff persons available to work on assessment and closure. Smaller municipalities may have few, if any, paid professional staff, and will need to find other resources to implement a landfill assessment and closure.

1. Key Players

For the large municipality with ample staff there are a number of key players. Of particular importance will be the technical role of the town engineer or DPW superintendent who will have first hand knowledge of landfill operations and some understanding of what may be required for landfill assessment and closure. They will play an important role in oversight of consultants hired to conduct a landfill assessment and/or closure. A town planner fills the coordination role, and will be knowledgeable about the project scheduling, and communications with local officials and the citizenry. The town administrator or manager will be the key financial person. He or she will be most familiar with contracting requirements, and will be the lead person in communications with the select board or town council.

2. Volunteer Recruitment

In smaller municipalities lacking professional staff persons, it will be important to find regional professional staff or volunteers to fill these three key roles; technical, coordination, and administrative liaisons. In most communities sufficient expertise is available to draw from. The problem is one of recruiting volunteers initially and keeping them involved.

Availability of volunteer staff is not necessarily tied to a municipality's size or affluence. Larger populations do provide a bigger pool to draw volunteers from; as do communities with a large retiree population and/or many single wage earning households by providing more individuals with free time to volunteer. The biggest factor, however, is the openness of the local officials to volunteer efforts, and the effectiveness with which a local government can work with these volunteers.

New volunteers looking to give their time to an activity will quickly discover whether their help is really wanted, and how much decision making authority they will have. A balance must be struck in giving volunteers sufficient quantity and quality work to keep their interest, and not giving them so much that they quickly burn out. Volunteers must be provided some level of autonomy and decision making authority or a shared decision making process. It is also important from the start to show the volunteers some structure and organization, otherwise they may drop out perceiving the project as a waste of their time.

The project organizers should be prepared to discuss goals and expected outcomes of the project, and determine the expectations of others attending the meeting. This will help to maximize people's available time, and help to head-off scattered agendas being moved forward. Volunteers should leave the first meeting with an expectation of the time they will need to commit to the project, and project chairpersons should know what time and activities volunteers are committing to the project.

B. Municipal Coordination of the Committee

A formal group or committee should be established to oversee the landfill assessment and closure. The committee membership will consist of the players discussed above.

1. Establishment of the Committee

Establishment and coordination of the committee is often carried out by a town planner or Board of Health (BOH). These activities will include pulling together local officials or other key players, recruiting volunteers and setting up the guidelines for the first meeting in which the committee is established.

The committee should operate within the framework of the community's Integrated Solid Waste Management plan or program. It should have a broad based constituency to maximize effectiveness and help in getting the project through critical stages. It should extend the coordination process through the solid waste activities (i.e. recycling, household hazardous waste collection) ongoing within the community.

In addition to recruitment through the public meeting process, other methods will be needed to recruit volunteers to the committee. Recruitment can be done through local papers, cable television, and attendance at municipal board meetings. It is very useful to have people on the committee who are either full or associate members of a local board. Again, the committee should be broad based, keeping in mind the key roles which will need to be filled, and time commitment which is available from each person.

2. Documentation

The planner or BOH official should be responsible for maintaining a paper trail which adequately documents the decision making process and the decisions which were made. This will be important should there be a turnover of committee members and is useful to document contracting procedures. It is also important to document the assignment of activities and deadlines, to make sure that all the committee members are aware of project milestones and outputs to be produced.

3. Sufficiency of Resources

Finally, it is important that an adequate number of people are available to form a "critical mass" for the committee. Prior to implementing the assessment and closure process it may be necessary to assess the project in light of other pending or ongoing activities to decide if it can be successfully undertaken. This should be done for the project as a whole and for volunteers and professionals who will work on the project.

To aid in making this determination committee members need to look at other ongoing activities which they are involved in and the time requirements for each activity. (This will be critical for the key players in the assessment and closure process.) Once activities and time requirements are determined, the committee can determine whether there are sufficient resources available for the project. Project management software packages are available to aid in this analysis, determining timing considerations and tracking individual activity and time commitments.

III. PLANNING AND SCHEDULING

A. Overview of Activities

Planning tasks begin well before the initiation of contracting or landfill site activities. The committee should remain active until the Department of Environmental Protection has signed-off on the closure and post-closure monitoring and uses. The critical time of local involvement will be during the contracting process, but should not overshadow careful preparation leading into the RFP process and oversight of the assessment and closure activities once a formal contractual agreement has been made between the community and consultant.

B. Need for Public Participation and Education

In cases involving municipal landfills, the community should be aware of landfill activities through board of health and selectboard/ town council meetings. Since the project will require appropriations of local funds, and possibly increased solid waste charges to residents, it is important that the community understand what is going on and why. Public information meetings and educational activities will provide a means of establishing support for project funding and recruitment of volunteers to serve on the assessment and closure committee.

People living in proximity to the landfill should be sought out for the public participation process. This group will be most directly impacted financially and environmentally by landfill activities. In the Initial Site Assessment stage, long-time residents can be a valuable source of information regarding historical use of the facility. Similarly, past public officials and volunteers may be familiar with related studies conducted for the community. Frequently the board members at the time a study was completed retain copies of the study.

The first public meeting should occur soon after the decision is made to look into conducting the assessment and closure. Few if any decisions should be made prior to opening up the process to the public. Initial committee formation should be an outcome of this first public meeting.

C. Pre-Assessment Activities

1. Committee Volunteer Roles

Along with the professional or official roles discussed in Section II above, there are a number of key roles to be filled either by volunteers, municipal officials or professional staff.

Committee Officers

Preferably a municipal committee should be established minimally with a chairperson (preferably co-chairs) and a recorder. The chairperson will be responsible for communications between the municipality (selectboard, town council, or town administrator) and the committee. This person will also oversee activities undertaken by the committee and its sub-committees. The recorder's role will be to document the decision making process. If not done by a local official, the role should be closely coordinated with the municipal official in charge of the project.

Coordinator
In a busy municipality, it may be necessary to establish a project coordinator other than a local planner. This person will coordinate activities between local boards, professional staff and the citizenry. When the coordination function is not part of the planning process the various participants may move in different directions based on their perception of the process. This problem can continue until a milestone is missed or until the project starts to fall apart.

Procurement Officer
If the municipal procurement officer is not a participant of the committee, then a person should parallel this function for the committee. The procurement officer will be the point person for contracting activities.

Meeting Facilitator
A meeting facilitator plays an important role in nearly all meetings both formal and informal. The function of the facilitator is to monitor the meeting, seeing that people who want to talk have the opportunity, and that the meeting is not usurped by one individual or topic. This function may be carried out by the committee coordinator or chairperson. However, especially in more formal settings, the function should be separated.

Public Information Spokesperson
A public information person serves the function of maintaining support for the project through news articles, talking to civic groups, municipal board meetings, school activities and phone hotlines. This role is most important near town meeting appropriation time.

Negotiator
A designated negotiator serves as spokesman for the committee when determining contractual details of the assessment and closure work. A skilled negotiator will help make the contracting process move smoothly, and the end products will better meet the committee's needs.

Many of the roles discussed above may be grouped under individual persons or may be shared by a sub-committee depending on the professionals and volunteers available to work on the project. These are all important functions which should be delegated to committee members with the skills and inclination to carry them out.

D. Timing and Planning Considerations

There are three major timing constraints. First, there are the regulatory constraints established by the State Solid Waste Regulations. The second set of constraints come from the local government process. The third set are related to construction work and consultant scheduling.

1. Regulatory Constraints

Under the Massachusetts Solid Waste Regulations, 310 CMR 19.000, facilities must undertake closure activities and close in accordance with the following schedules:

1. Landfills which will close on or before July 1, 1992 must submit a final closure and post-closure plan prior to closure of the facility.

2. Landfills which will stop accepting waste prior to January 1, 1994 must submit an interim closure plan by July 1, 1992.

3. Landfills located in restricted areas, including Zone IIs, Interim Wellhead Protection Areas, unmonitorable area, or over a Sole Source Aquifer) must close by July 1, 1995. This requirement means that the facility must complete all closure activities prior to that date.

4. Unlined areas of landfills must stop accepting solid waste in unlined phases prior to January 1, 1994 and must have completed all closure activities in those unlined phases no later than July 1, 1995.

5. Inactive landfills which accepted waste after April 21, 1971 which cannot demonstrate that they closed in accordance with plans approved by the Department must submit a final closure and post-closure plan by January 1, 1992.

Final closure plans submitted under any of the above schedules are required to have the results of an Initial Site Assessment and a scope of work for a Comprehensive Site Assessment submitted as a part of the closure plan. Planning for completion of the final closure plan must allow for the time it will take to complete the Initial Site Assessment and develop a scope of work for the comprehensive assessment so that these tasks will be completed in time to incorporate into the final closure plan. In the case where an interim closure plan is submitted (see #2 above), the interim closure plan must include a schedule for undertaking an ISA and developing the scope of work for the CSA.

2. Local Constraints

The major local constraint will be the town meeting approval process and fund allocation. Unless a Board of Health has sufficient funds in their operating budget to conduct the assessment, the Board will need to request funding through the town meeting process. This will require several months to prepare and receive approval for a warrant article, and sell the project to the electorate. This process will proceed more quickly in municipalities which have a Town Council form of government as there are less formalities and shorter time frames involved. It may be possible to initiate the initial site assessment with existing funds while gearing up for larger appropriations to finance the comprehensive assessment and closure.

3. Contracting Constraints

The two constraints affecting contracting are the construction season and scheduling. Seasonal variations determine when wells can be installed and when they should be sampled. Wells cannot be installed during severe winter conditions. Once installed they will need to be sampled during each season in the course of a year. In selecting a contractor to conduct the assessment, their availability to stay on schedule will be an important element of the selection criteria.

4. Scheduling

An ideal schedule would call for preparation of the warrant article at least three months prior to the spring town meeting. The committee would hold informational sessions, prepare news articles and flyers, and lobby for approval of the warrant article prior to the town meeting. Following approval, the committee would initiate the RFP process with a July target date for contract completion and initiation of the initial site assessment and development of the scope of work for the comprehensive assessment.

This will allow for approval of the Comprehensive Site Assessment Scope of Work in early fall, and completion of well installation and a first round of sampling before the end of the construction season. Corrective Action Alternative Analysis and Closure Design could be conducted the following winter once the assessment is completed and construction of the closure alternative could start early in the construction season. Funding for the closure design and construction would be placed on the town meeting warrant for the spring following initial approval or could be appropriated at a fall special town meeting.

Should this process begin with a fall appropriation of funds, the initial site assessment would be conducted during the winter and the comprehensive assessment would start in early to mid-spring. This would set the project back three to six months but would still meet the compliance schedule of the State solid waste regulations.

IV. CONCLUSIONS

In summary, it is important that local officials initiating a landfill assessment and closure tap into expertise within the community to form their committee. Early on, the committee should begin building a base of support through public information and education. Finally, the committee should take the time needed to understand the project details and formulate a plan to carry out these activities. Time spent in planning for these activities will be saved over the course of the assessment and closure process.

CHAPTER 15 INTEGRATED SOLID WASTE MANAGEMENT

I. INTRODUCTION

Integrated solid waste management employs the hierarchy of first source reduction, then recycling, incineration, and finally landfilling as a means of providing waste disposal capacity.

This Chapter will begin with a broad discussion of the facets of integrated solid waste management (ISWM). It will then focus on how landfill assessment and closure fits into this bigger picture. The Chapter will conclude with some suggestions for successful implementation of a municipal integrated solid waste management plan.

II. INTEGRATED SOLID WASTE MANAGEMENT - As Defined by the U.S. EPA

"Integrated solid waste management involves using a combination of techniques and programs to manage the municipal waste stream. It is based on the fact that the waste stream is made up of distinct components that can be managed and disposed of separately. An integrated system is designed to address a specific set of local solid waste management problems, and its operation is based on local resources, economics, and environmental impact."

A. Waste Disposal

"The idea behind ISWM is that a combination of approaches can be used to handle targeted portions of the waste stream. Instead of immediately driving the development of big facilities or setting unrealistic recycling expectations, decision makers implement a series of programs each of which is designed to compliment the others. Source reduction, recycling, combustion, and landfilling can all have a positive impact on the local municipal waste management program."

"Source reduction, at the top of the hierarchy, is designed to reduce both the toxic constituents in products and quantities of waste generated. Source reduction is a front-end waste management approach that may occur through the design and manufacture of products and packaging with minimum volume and toxic content, and longer useful life. It can be practiced in the office and home through selective buying and material and product re-use.

"Recycling, including composting, is the second step of the hierarchy. These options can reduce the deletion of landfill space, save energy and natural resources, provide useful products and prove economically beneficial.

"Waste combustion and landfilling comprise the remainder of the hierarchy. Combustion (or incineration) reduces the bulk of municipal waste and can provide the added benefit of energy production. State-of-the-art technologies have greatly reduced the adverse environmental impacts associated with incineration in the past. Landfilling is necessary to manage non-recyclable and non-combustible waste and is the only actual waste 'disposal' method. Modern landfills are more secure and have more elaborate pollution control and monitoring devices than in the past.

B. Resource Management

A second aspect of ISWM is the compatible utilization of municipal resources including staff persons and funds. Part of determining the mix of waste disposal options for the community includes development of a ISWM plan, coordination of municipal waste staff persons, and establishment of a funding mechanism to finance ISWM activities.

From the staff perspective ISWM involves coordination of all the individuals, paid and volunteer, working on different aspects of solid waste management within the community. The focus should be on elimination of duplicity of tasks and maintaining open communications.

By expanding these activities outside the municipal boundaries to regional and private organizations the effectiveness of municipal ISWM can be increased. Regional collaborations can provide benefits to a municipality through economies of scale, for examples in developing markets for recycled goods. Burden sharing is another benefit, where a group of communities share the responsibility for the components of one regional ISWM system (community A hosts the landfill, community B hosts the recycling center).

Quasi-governmental authorities can be created to oversee regional solid waste management and implement large-scale facilities which could not be financed by a single community. These also provide some insulation from local politics. Table 14-1. presents some of the pros and cons of regional organizations.

Private/public ventures can bring alternative approaches to project implementation and may provide additional revenue for project funding. Municipalities should work closely with their private haulers, processors, secondary materials industries and local utilities in developing an ISWM plan to fully utilize existing waste management potential.

III. HOW LANDFILL ASSESSMENT AND CLOSURE FITS IN

A. Environmental Protection

The third major aspect of ISWM is environmental protection. This includes protecting community public health and safety and protecting community natural resources; including water supplies, wetlands and areas of critical environmental concern. Solid waste regulations now require new sanitary landfills to be lined and have leachate collection systems, to prevent pollution of surface water and control landfill gas.

Environmental protection is the consideration by which commercial and industrial hazardous wastes are handled and disposed of separately from municipal waste. Likewise household hazardous wastes, including waste motor oil and car batteries should be disposed of separately.

Table 14-1: REGIONAL ORGANIZATIONS

OPTION	ADVANTAGES	DISADVANTAGES
Authorities	Ability to finance without regard to local debt ceiling and without obtaining voter approval; Service less likely to be hampered by local political activity because board members are usually private citizens; Autonomy and freedom from municipal budgetary and administrative control may mean more efficient delivery of service; and Can generate sufficient income to make service self-supporting, and capital financing is tax-exempt.	Financing can be administratively complex; Can become remote from government or public control; and Can compete with private industry in some areas of operation, reducing the efficiency of both.
Special Districts	The district has a distinct constituency of residents, not merely a group of bondholders living in scattered places; and Governments can be protected by having elected county officials serve as governing body of district.	Powers are limited by State statute; Must rely on special tax levies requiring voter approval; and Creates an additional governmental entity removed from the electorate and thus less responsive to citizens than directly-elected entities.
Nonprofit Public Corporations	Financing is outside government debt limits and can be obtained without voter approval; Corporation gives its assets to cities after bonds are paid; and No real estate or Federal taxes, and capital financing is tax exempt.	Political influence may be exerted and flexibility lost because board members are city, county, and State officials; Difficult to dismantle even if better service becomes available; and Does not have full faith and credit of the taxing power of the communities behind the financing.
Multi-Community Cooperatives	Less restrictive in legal and institutional structure than Authorities, Special Districts, and Public Corporations; and; Enables member communities to provide services not otherwise financially or administratively feasible and provides for more effective contractual agreements.	Member communities lose autonomy in locating waste disposal sites, setting charges for use of system, and other decisions; Increased interest costs when leading community is less creditworthy than other members; and Leader community may require financial assurances through contractual arrangements with member communities.
Inter-Governmental Agreements	The most widely used method of cooperation between governments in the United States; Contracts offer flexibility, while being both predictable and enforceable; Basic governmental structures and organizations are not affected; and Since no reorganization is required, much time can be saved.	It may be difficult to obtain capital financing since each of the communities, rather than a single unit, must borrow money; If agreements are not formalized in detail through a contract or other mechanism, misunderstandings may arise later; and Since there is no single corporate body, all participants must reach agreement each time a new issue arises.

Source: U.S. E.P.A.

Environmental protection has also been the impetus for regulations requiring that inactive landfills undergo the assessment and closure process. Under an ISWM approach, landfilling is the end point of all final solid waste disposal; incinerator ash, recycling residuals; and other non-reducible wastes. Landfill assessment and final closure are the ultimate steps in securing the landfill and thus complete the ISWM cycle.

Failure to incorporate landfill assessment and closure into a municipal ISWM plan prolongs this inevitable event. In the interim, pollutants continue to emanate from the landfill creating greater threats to the environment. Costs to complete this work increase due to inflation and further migration of contaminants from the site. Addressing assessment and closure outside of the municipal ISWM program complicates management of both these activities.

B. Financing ISWM

In order to obtain funding for a new sanitary landfill, costs are carefully calculated for all aspects of construction and operation, including pre-construction site assessment. The 1990 solid waste regulations require that an applicant proposing a new facility determine and set aside funds to conduct final assessment and closure of the facility once it reaches its capacity.

In determining revenues to be generated by the landfill, the applicant determines the net amount of waste which will be received by the facility after subtracting estimates for source reduction, composting and recycling, and competing disposal facilities. The operator then estimates development, operation, assessment, closure and post-closure costs. It is in this manner that a new facility operator incorporates environmental control of the landfill into the ISWM process.

This analysis and incorporation of assessment, closure and post-closure becomes more difficult for an existing landfill which no longer receives solid waste. The primary problem is that there is less incentive to initiate the assessment and closure as the facility no longer generates revenue. This is less of a problem when assessment and closure costs are being calculated for active landfills as both expenditures and revenue relate to the facility. The revenue from the facility can be adjusted to buffer the assessment, closure and post closure costs. Regardless of the landfill status, assessment and closure should be factored into the ISWM formula, incorporating all present and future costs; it is the true cost of integrated solid waste management for the community.

Most municipalities have historically charged little or no fee for waste disposal. Many communities residents have recently faced the shock of a dramatic rise in waste disposal costs as communities have switched over to new local or regional disposal facilities. In some instances these increases have come when water and sewer rates have also drastically increased. It becomes difficult for municipal officials to propose additional assessment related increases, yet there really aren't other options.

Other municipalities are operating sanitary landfills which have a few years of remaining capacity. Officials in these communities can take advantage of this capacity to raise revenues which will help to finance assessment and closure of the landfill, and implementation of other waste management alternatives. The way in which officials can cushion this shock is by the development of an ISWM plan which addresses the assessment and closure of inactive landfills as part of the plan.

IV. IMPLEMENTATION STRATEGIES

It is critical that municipal officials formulate a plan which incorporates all the aspects of integrated solid waste management. It is also critical that this plan be flexible; allowing for evaluation and adjustment at regular intervals to incorporate changes as they occur. An ISWM plan should be implementation oriented, emphasizing how the different parts will work together, and how they will become operational.

Finally, the ISWM plan must be concise. Given the present budgetary shortfalls of many municipalities, any planning process will need to be done primarily by in-house staff and volunteers. Money spent on extensive analysis and characterization of local solid waste trends will be money not available for plan implementation. Where possible, municipalities should work with existing regional data estimates making adjustments as deemed appropriate.

Local ISWM plans should also be consistent with the State Master Plan and solid waste regulations. These will determine in large part the schedule for waste diversion from landfills and transfer stations.

Planning for the Landfill Closure

Implementation strategies for post-landfill solid waste disposal should be developed one to two years prior to the ceasing disposal of waste in the sanitary landfill. If your community is planning to close it's landfill beginning in January 1994, it is not too early to begin planning for future solid waste disposal. In addition to the physical solid waste disposal mechanism, a community should be assessing the added cost associated with new disposal, recycling and composting and landfill assessment and closure.

The primary effect of a community losing its landfill is the loss of low/no cost disposal of MSW. In good or bad times, this presents some critical decisions. The driving question is how to raise funding for increased disposal and transportation costs. But, in order to adequately address this problem, some thought must be given to the entire solid waste management picture. Recycling and composting must be considered as means to divert as much of the waste stream as possible from the disposal site. The following breaks out some of the key questions that can help develop an adequately funded, integrated solid waste management plan with recycling and composting as components. A brief discussion of each critical area is included as well as a list of the available options (or choices).

Post-Landfill Solid Waste Management

In assessing how solid waste will be disposed of subsequent to landfill closure, your community should consider what materials can be separated out of the municipal waste stream by recycling and composting. Another area to be considered is the segmenting of residential and commercial waste streams.

Disposal and Collection Systems:

A community is presented with two options for solid waste collection. The first is to construct a transfer station for local waste collection. Waste is then shipped in trailers to a regional disposal facility. Money is saved by decreased trucking costs and decreased staffing for collection.

A community intending to construct a transfer station on the existing landfill site should provide time and resources for the additional time needed for the actual transfer station planning and construction and the complications which will arise in integrating the transfer station into the landfill closure plan.

The second Option for waste disposal is curbside collection of solid waste. This can be contracted out in its entirety as part of a private collection/disposal contract; it can be contracted out separately from a private disposal contract; or a community can use its public works staff to manage waste collection.

Another alternative is to leave it up to the individual homeowner to contract independently with waste haulers. A community taking this approach may want to screen or otherwise license haulers who operate in their community.

Considerations connected to waste hauling include how recycling and composting will tie into the formula. A community can have multiple collections for solid waste, recyclables and yard waste. As an alternative, you can provide for collection of solid waste and provide a drop-off center for recyclable materials and yard wastes. Some communities have special seasonal collections for yard waste and special wastes (furniture and large appliances) while others provide drop-off services for solid waste materials but maintain a curbside collection of recyclable materials.

There are many options and alternative means of reaching the same results. It takes time and planning for a community to determine their best approach based on past disposal practices, available resources and citizen input. It is important to give yourself sufficient time and resources to make these decisions before you reach the point where alternative waste disposal is needed. The following section presents a list of choices which will help you to determine the best possible waste disposal options for your community.

Choice of Disposal

Choices are: waste to energy incinerator, commercial landfill or regionally pooling waste stream with other communities with excess tonnage capacity in their contracts.

Choice of Collection

Choices are: curbside - municipal or contract, drop-off at transfer station - municipal or contract transportation to disposal site - scheduling special waste collections

Recycling and Composting:

When a community's solid waste begins to be disposed of at a commercial facility, the cost/benefit of initiating recycling and composting programs changes drastically. The cost of trucking materials to a regional disposal facility and the higher tip fees at the regional facility will make it worth your time to set up composting and recycling programs or maximize the efficiency of existing programs.

If your community is planning to enter a long-term waste disposal contract the time should be taken to project the amount of solid waste which will be handled by that contract. Many long term contracts hold a community liable for maintaining a consistent level of disposal and will be charged for a minimum tonnage regardless of whether it is disposed of or not. Therefore, it is important to factor in projected tonnage that can be recycled or composted.

Choice of Recycling and Composting Methods

Choices are: drop-off or curbside.

A. Solid Waste Financing and Accounting

Much of this document has been dedicated to a discussion of solid waste costs, financing and accounting methods. The reader is referred to Chapters Ten and Eleven for a discussion of these matters. Chapter Twelve of Decision-Makers Guide to Solid Waste Management, published by the EPA and listed in the reference also discusses this information. An analysis of these factors is integral to solid waste planning and decision making.

Choice of Funding

Choices are: tax levy, fees or leaving residents to arrange for collection and disposal themselves.

Choice of Accounting

Choices are: general fund or enterprise fund accounting

B. Summary

The time involved in working through all of these factors should not be underestimated. They will require substantial time to formulate, and work through the local government hierarchy. In planning for the assessment and closure of your landfill, realize that planning and budgeting for your community's new solid waste management system will be as time and resource intensive an undertaking as the assessment and closure process.

PART III. APPENDICES

APPENDIX A. COMMONLY USED CQA TESTS AND MONITORING PROCEDURES FOR SOLID WASTE LANDFILL CONSTRUCTION

Material	Parameter	Commonly Used Test Method	Reference Standard
Soils	Observation	Visual/Manual	ASTM D 2488
	Water Content	Standard Oven-drying	ASTM D 2216
		Standard Nuclear Gage	ASTM D 3017
		Calcium Carbide (Speedy)	AASHTO T217
	Unit Weight-Density (Field Methods)	Standard Sand Cone	ASTM D 1556
		Standard Water Balloon	ASTM D 2167
		Standard Nuclear Gage	ASTM D 2922
		Standard Drive Cylinder	ASTM D 2937
	Particle-size Analysis	Standard Sieve Method (+200 fraction)	ASTM D 422
		Standard Hydrometer Method (-200 fraction)	ASTM D 422
	Liquid Limit	Standard Multipoint Method	ASTM D 423
	Plastic Limit	Standard Method	ASTM D 424
	Laboratory Compaction	Standard Proctor	ASTM D 698
		Modified Proctor	ASTM D 1557
	Permeability (Laboratory)	Fixed-Wall Method Flexible-Wall or Triaxial Cell Method	No standard method
	Permeability (Field)	Double Ring Infiltrometer	ASTM D 3385
		Drum Test	Federal Bentonite, 1983
	Cation Exchange Capacity	Methylene Blue Test	Federal Bentonite, 1983
Flexible Geomembranes;			
CPE and CSPE (reinforced)	Thickness (overall)	---	ASTM D 751
	Breaking Strength	Grab Method A (CSPE)	ASTM D 751
	Tear Strength	Tongue Tear Method B*	ASTM D 751
	Ply Adhesion	Machine Method, Type A	ASTM D 413
	Dimensional Stability	212°F, 1 hr	ASTM D 1204
	Bonded Seam Strength	Grab Method A*	ASTM D 751
	Peel Adhesion	180 degree peel, 2 inch/min	ASTM D 413
HDPE and PVC (non-reinforced)	Thickness	Para. 8.1.3	ASTM D 1593
	Minimum Tensile Properties	HDPE	ASTM D 638
		PVC (Method A or B) (1 inch wide)	ASTM D 882

Material	Parameter	Commonly Used Test Method	Reference Standard
HDPE and PVC (non-reinforced) (cont.)	Tear Resistance	Die C	ASTM D 1004
	Dimensional Stability	212°F, 15 min	ASTM D 1204
	Bonded Seam Strength	Method A or B*	ASTM D 3083
	Peel Adhesion Peel	180 degree peel 2 inch min*	ASTM D 413
Geotextiles	Permittivity	---	ASTM D 4491
	Apparent Opening Size	---	ASTM D 4751
	Gradient Ratio	---	CW-02215
	Long-Term Flow	---	GRI-GT1
	Thickness	---	ASTM D 1777
	Tensile Properties	Grab Method	ASTM D 1682
	Tear Strength	---	ASTM D 1117 ASTM D 2263
	Burst Strength	Diaphragm	ASTM D 3786 ASTM D 774
	Puncture Resistance	Tension Machine	ASTM D 751 ASTM D 3787
Pipe	Leakage		
	non-pressure pipe	Low Pressure Air	WSDOT/APWA Sections 7-04 or 7-17
	pressure pipe	Hydrostatic	WSDOT/APWA Section 7-11
Concrete Structures	Sampling fresh concrete	---	ASTM C 172
	Consistency	---	ASTM C 143
	Making and curing concrete test specimens	---	ASTM C 31
	Unit weight, yield and air content	---	ASTM C 138
Foundation	Removal of unsuitable materials	Observation	NA
	Proof rolling of subgrade	Observation	NA
	Filling of fissures or voids	Observation	NA
	Compaction of soil backfill	(See low-permeability soil liner component)	
	Surface finishing	Observation	NA
	Sterilization	Supplier's certification and observation	NA
	Slope	Surveying	NA
	Depth of excavation	Surveying	NA
	Seepage	Observation	NA

Material	Parameter	Commonly Used Test Method	Reference Standard
Foundation (cont.)	Soil type (index properties)	Visual manual procedure	ASTM D 2488
		Particle size analysis	ASTM D 422
		Atterberg limits	ASTM D 4318
		Soil classification	ASTM D 2487
	Cohesive soil consistency (field)	Penetration tests	ASTM D 3441
		Field vane shear test	ASTM D 2573
		Hand penetrometer	Horslev, 1943
		Handheld torvane	Lanz, 1968
		Field expedient unconfirmed compression	TM 5-530 (U.S. Dept of Army, 1971)
	Strength (laboratory)	Unconfined compressive strength	ASTM D 2166
		Triaxial compression	ASTM D 2850
		Unconfined compressive strength for soil-cement	ASTM D 1633
Dikes	Dike slopes	Surveying	NA
	Dike dimensions	Surveying; observations	NA
	Compacted soil	(See low-permeability soil liner component)	
	Drainage system	(See leachate collection system component)	
	Erosion control measures	(See cover system component)	
Low-permeability soil liner	Coverage	Observation	NA
	Thickness	Surveying; measurement	NA
	Clod size	Observation	NA
	Tying together of lifts	Observation	NA
	Slope	Surveying	NA
	Installation of protective cover	Observation	NA
	Soil type (index properties)	Visual-manual procedure	ASTM D 2488
		Particle size analysis	ASTM D 422
		Atterberg limits	ASTM D 4318
		Soil classification	ASTM D 2487
	Moisture content	Oven-dry method	ASTM D 2216
		Nuclear method	ASTM D 3017
		Calcium carbide (speedy)	AASHTO T 217
		Frying pan (alcohol or gas burner)	Spigolon & Kelley (1984)
	In-place density	Nuclear methods	ASTM D 2922
		Sand cone	ASTM D 1556
		Rubber balloon	ASTM D 2167
		Drive cylinder	ASTM D 2937
	Moisture-density relations	Standard proctor	ASTM D 698
		Modified proctor	ASTM D 1557
		Soil-cement M-D test	ASTM D 558

Material	Parameter	Commonly Used Test Method	Reference Standard
Low-permeability soil liner (cont.)	Strength (laboratory)	Unconfirmed compressive strength	ASTM D 2166
		Triaxial compression	ASTM D 2850
		Unconfirmed compressive strength for soil-cement	ASTM D 1633
	Cohesive soil consistency (field)	Penetration tests	ASTM D 3441
		Field vane shear test	ASTM D 2573
		Hand penetrometer	Horslev, 1943
		Handheld torvane	Lanz, 1968
		Field expedient unconfined compression	TM 5-530 (U.S. Dept of Army, 1971)
	Permeability (laboratory)	Fixed wall	EPA, 1983 SW-870
		Flexible wall	Daniel et al, 1984 Daniel et al, 1985 SW-846 Method 9100 (EPA, 1984)
	Permeability (field)	Large diameter single-ring infiltrometer	Day and Daniel, 1985
		Sai-Anderson infiltrometer	Anderson et al, 1984
	Susceptibility to frost damage	Susceptibility classification	Chamberlin, 1981
		Soil-cement freeze-thaw test	ASTM D 560
	Volume change	Consolidometer (undisturbed or or remolded sample)	Holtz, 1965
		Soil-cement wet-dry test	ASTM D 559
		Soil-cement freeze-thaw test	ASTM D 560
Flexible membrane liners	Thickness	Thickness of unreinforced plastic sheeting (paragraph 8.1.3, dead-weight method--specifications for nonrigid vinyl chloride plastic sheeting)	ASTM D 1593
		Thickness of reinforced plastic (testing coated fabrics)	ASTM D 751
	Tensile properties	Tensile properties of rigid thick plastic sheeting (standard test for tensile properties of plastics)	ASTM D 638
		Tensile properties of reinforced plastic sheeting (Grab method A--testing coated fabrics)	ASTM D 751
		Tensile properties of thin plastic sheeting	ASTM D 882
	Tear strength	Tear strength of reinforced plastic sheeting (modified tongue tear method B--testing coated fabrics)	ASTM D 751
		Tear strength of plastic sheeting (Die C--test method for initial tear resistance of plastic film and sheeting)	ASTM D 1004

Material	Parameter	Commonly Used Test Method	Reference Standard
Flexible membrane liners (cont.)	Bonding materials	Manufacturer's certification	NA
	Bonding equipment	Manufacturer's certification	NA
	Handling and storage	Observation	NA
	Seaming	Ply adhesion of reinforced synthetic membranes, bonded seam strength in peel (machine method, Type A test methods for rubber properties, adhesion to flexible substrate)	ASTM D 413 ASTM D 4437
		Bonded seam strength in shear of reinforced plastic sheeting (modified grab method A--testing coated fabrics)	ASTM D 751
		Bonded seam strength in shear of unreinforced plastic sheeting (modified)	ASTM D 3083
	Sealing around penetrations	Observation	NA
	Anchoring	Observation	NA
	Coverage	Observation	NA
	Installation of upper bedding layer	Observation	NA
Leachate collection system			
Granular drainage and filter layers	Thickness	Surveying; measurement	NA
	Coverage	Observation	NA
	Soil type	Visual-manual procedure Particle size analysis Soil classification	ASTM D 2488 ASTM D 422 ASTM D 2487
	Density	Nuclear methods Sand cone Rubber balloon	ASTM D 2922 ASTM D 1556 ASTM D 2167
	Permeability (laboratory)	Constant head	ASTM D 2434
Synthetic drainage and filter layers	Material type	Manufacturer's certification	NA
	Handling and Storage	Observation	NA
	Coverage	Observation	NA
	Overlap	Observation	NA
	Folds and wrinkles	Observation	NA
	Temporary anchoring	Observation	NA

Material	Parameter	Commonly Used Test Method	Reference Standard
Synthetic drainage and filter layers	Geotextile properties	Tensile strength	Horz (1984)
		Puncture or burst resistance	Horz (1984)
		Tear resistance	Horz (1984)
		Flexibility	Horz (1984)
		Outdoor weatherability	Horz (1984)
		Short-term chemical resistance	Horz (1984)
		Fabric permeability	Horz (1984)
		Percent open area	Horz (1984)
		Pipes	Material type
Manufacturer's certification	NA		
	Handling and storage	Observation	NA
	Location	Surveying	NA
	Layout	Surveying	NA
	Orientation of perforations	Observation	NA
	Jointing		
	o Solid pressure pipe	Hydrostatic pressure test	Section 4, AWWA C600
	o Perforated pipe	Observation	NA
Cast-in-place concrete structures	Sampling	Sampling fresh concrete	ASTM C 172
	Consistency	Slump of portland cement concrete	ASTM C 143
	Compressive strength	Making, curing, and testing concrete specimens	ASTM C 31
	Air content	Pressure method	ASTM C 231
	Unit weight, yield and air content	Gravimetric method	ASTM C 138
	Form work inspection	Observation	NA
Electrical and mechanical equipment	Equipment type	Manufacturer's certification	NA
	Material type	Manufacturer's certification	NA
	Operation	As per manufacturer's instructions	NA
	Electrical connections	As per manufacturer's instructions	NA
	Insulation	As per manufacturer's instructions	NA
	Grounding	As per manufacturer's instructions	NA
Cover system o Cover foundation	Waste placement records/ waste placement process	Observation	NA
	Soil backfill	(See foundation component)	

Material	Parameter	Commonly Used Test Method	Reference Standard
o Low permeability soil barrier	(See low-permeability soil liner component)		
o Flexible membrane barrier	(See flexible membrane liner component)		
o Bedding layer	(See flexible membrane liner component)		
o Drainage and gas venting layers	(See leachate collection system component)		
o Topsoil and vegetation (erosion control measures)	Thickness	Surveying	NA
	Slope	Surveying	NA
	Coverage	Observations	NA
	Nutrient content	Various procedures	Page, 1982
	Soil pH	Soil pH, lime requirement	Page, 1982
	Soil type; moisture content	(See low-permeability soil liner component)	
	Vegetation type	Supplier's certification; observations	NA
	Seeding time	Supplier's recommendations observations	NA

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* Test method as modified by National Sanitation Foundation Standard Number 43, Appendix 54

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APPENDIX B. LANDFILL PLAN SUBMITTAL CHECKLISTS

I. SITE PLAN

The Site Plan shall consist of a locus and site plan providing the following information:

A. Locus Plan

________________ 1. On USGS Topo or equivalent

________________ 2. North arrow and other geodetic control

________________ 3. Public water supply well w/in 15,000 feet,

________________ a. Zone II (or IWPA) established

4. Airport runways w/in 10,000 feet

________________ a. runway length <4000 feet w/in 5,000 feet of landfill

________________ b. runway length >4000 feet or known to be used by jets w/in 10,000 feet of landfill

________________ 5. Site assigned area

________________ 6. Identify public surface water supplies w/in 15,000 feet

________________ 7. Areas of Critical Environmental Concern

B. Site Plan

________________ 1. Scale 1:2400 to 1:4800 (1"=200′ to 1"=400′)

2. Topography for landfill and local region

________________ a. contour interval < = 5 feet

________________ 3. North arrow, bench marks and other geodetic control

________________ 4. Boundaries and acreage of the site and the boundaries of the landfilling operation on the site

________________ 5. Property boundary

________________ a. >100 feet from refuse

______________ 6. Site assigned boundary (if different from property boundary

______________ a. Property contained w/in

______________ 7. Existing residential et al buildings

______________ a. >500 feet from refuse

______________ 8. Other existing buildings

______________ 9. The location and identification of adjoining and other residential, commercial and industrial property within 1000 feet of the property boundary

______________ 10. Land use map of zoning for a one-half mile radius around the landfill

______________ 11. Surface water supply

______________ a. > 2500 feet from refuse in down-gradient position

______________ b. > 500 feet from refuse in up-gradient position

______________ 12. Wetlands, flood plains, other areas protected under c.131, s.40

______________ a. wetlands >100 feet from refuse

______________ b. filling of flood plain

______________ 13. Surface Water

______________ a. > 250 feet from perennial watercourse

______________ b. Does perennial watercourse draw to surface water drinking supply < 1 mile from landfill

______________ c. > 250 feet from lake, pond or navigable river

______________ 14. Private water supply wells

______________ a. > 500 feet from refuse

______________ b. the location of all private drinking water wells within one-half mile of the boundaries of the landfill

_______________ 15. Zone II (or IWPA)

_______________ a. is it identified

_______________ b. refuse w/in zone

_______________ 16. Areas of Critical Environmental Concern

_______________ a. refuse w/in area

_______________ 17. Proposed buildings, roads and appurtenant works

_______________ 18. Proposed leachate treatment facility

_______________ 19. Proposed gas treatment facility

_______________ 20. Proposed storm run-off discharges and sediment control basins

_______________ 21. Proposed leachate discharge points

_______________ 22. Proposed groundwater discharges

_______________ 23. Hot load area

_______________ 24. Fire hydrants and other sources of water for fire protection

_______________ 25. The location and elevations of all existing monitoring devices or surface water monitoring locations. This includes groundwater monitoring wells, piezometers, lysimeters or other monitoring devices.

_______________ 26. Sanitary facility location(s)

_______________ 27. Administrative office location

_______________ 28. The location of all soil borings, excavations and test pits

_______________ 29. The location of all on-site borrow sources

_______________ 30. The locations of all existing and proposed utilities (including power lines), structures (including fences and gates) and roads

_______________ 31. Locations of permanent bench marks

_______________ 32. Registered Professional Engineer stamp

II. DESIGN PLAN

The design plan shall contain an engineering report, engineering drawings and plans sheets, a construction plan, a QA/QC plan and design and construction technical specifications.

A. Engineering Report

The engineering report should provide a narrative detailing the engineering basis for the proposed design. This should include site history, engineering assumptions, design calculations, and references. The report should include, but not be limited to:

______________ 1. Site description

______________ 2. Site history

______________ 3. Description of region

4. Facility description

______________ a. Total site area

______________ b. Assigned area

______________ c. Refuse disposal area

______________ d. Average daily tonnage

______________ e. Peak daily tonnage

______________ f. Days of operation

______________ g. Weekly tonnage

______________ h. Hours of operation

______________ i. Service community

______________ j. Site owner

______________ k. Permittee/applicant

______________ l. Operator

______________ m. Waste types

______________ n. Auxiliary operations

______________ (1) Recycling

______________ (2) Composting

______________ (3) Other (specify):
5. General operating procedures
______________ a. Sequence of operation
______________ b. Auxiliary activities
______________ c. Special wastes
______________ 6. Construction sequence
______________ 7. Location of water supply of fire control
______________ 8. Specifications, operation equipment
9. Capacity and life expectancy of
______________ a. Each phase
______________ b. Entire facility
10. Leachate management
______________ a. Efficiency of liner
______________ b. Quantity of leachate
11. Gas management
______________ a. Types and quantity of gas generated
______________ b. Control strategy
12. Water management
______________ a. Run-off - Run-on
______________ b. Precipitation - Infiltration
13. Stability analysis
______________ a. Foundation soils
______________ b. Slope stability
______________ c. Soil-membrane-geotextile stability

B. Engineering Drawings and Plan Sheets

Schematic drawings, maps or plan sheets which delineate in plan and in detailed cross-sectional view which include:

_______________ 1. The existing conditions of the proposed landfill site showing all subsurface exploration points and results

_______________ 2. The final elevations of any excavations showing all grades of the liner and the subgrade

_______________ 3. The intermediate and final elevations of the landfill

_______________ 4. The leachate collection system showing all grades of the collection pipes, drainage layer, manhole/clean-out risers and sumps

_______________ 5. All berms, dikes, ditches, swales, or other protection devices needed to divert or collect surface water run-on or run-off

_______________ 6. The system to be utilized for venting and monitoring the gasses generated within the landfill and, if applicable, from beneath the liner

_______________ 7. The final elevations and grades of the final cover including the subgrade for the impervious cap, the drainage layer and vegetative layer

_______________ 8. All grades of the leachate treatment and disposal systems including the leachate removal pipes, treatment or pre-treatment ponds or storage facilities

_______________ 9. All proposed landscaping and screening techniques to be utilized to minimize the visual impact of the landfill

_______________ 10. North arrow bench marks and other geodetic control

_______________ 11. Existing contours

_______________ a. 2 foot contours

_______________ 12. Existing subsurface geology

_______________ 13. Existing peak ground water table

_______________ 14. Ground water control system

________________ 15. Access roadways

________________ 16. Buildings, scales and other appurtenant works

________________ 17. Facility utilities

________________ 18. Facilities for recycling, composting, etc.

________________ 19. Facilities for "Special Wastes"

________________ 20. Landscaping for buffer zones, etc.

________________ 21. Site access control

________________ 22. Special provisions to meet site assignment provisions

________________ 23. Operating sequence plans

________________ 24. Daily cover storage area

________________ 25. P.E. stamp

Additional drawings or detailed diagrams on a scale of 1:40 showing the construction specifications of:

________________ 1. The subgrade

________________ 2. The liner and/or any cut-off wall

________________ 3. The drainage layer

________________ 4. The collection pipes

________________ 5. The inlet/outlet structures

________________ 6. Manholes, sumps, pumps and pump stations

________________ 7. The leachate storage tanks

________________ 8. The leachate treatment impoundments or tanks

________________ 9. The leachate disposal systems and treatment systems, if applicable

________________ 10. Gas vents, manifolds and pump stations

________________ 11. Monitoring wells/devices

________________ 12. Surface drainage and erosion controls

________________ 13. The landfill cap and final cover

C. Construction Report

A description of the general installation methods and procedures for construction of the facility including materials required, equipment utilized and scheduling of construction events and phases. To ensure that the construction requirements of the regulations are properly implemented, the description should include a discussion of installation of the following:

________________ 1. The subgrades

________________ 2. Impermeable layers construction

________________ a. Materials testing requirement

________________ b. Placement requirement

________________ 3. The drainage layer

________________ 4. The collection pipes

________________ 5. The inlet/outlet structures

________________ 6. Manholes, sumps, pumps and pump stations

________________ 7. The leachate storage tanks

________________ 8. The leachate treatment impoundments or tanks

________________ 9. The leachate disposal systems, pump stations and treatment systems, if applicable

________________ 10. Gas vents, manifolds and pump stations

________________ 11. Monitoring wells/devices

________________ 12. Surface drainage and erosion controls

________________ 13. Final cover

________________ 14. Construction schedule

________________ 15. Structures

________________ a. Scale house

________________ b. Equipment shelter

________________ c. Other

D. QA/QC PLAN INCLUSIONS

A Quality Assurance/Quality Control Plan (QA/QC) should be included as part of the design plan. The QA/QC should outline the observations and tests to be used to ensure that construction of the landfill meets or exceeds all design criteria, plans and specifications. The QA/QC plan shall be the basis for the construction certification of the facility.

The QA/QC Plan includes the following:

______________ 1. Identity and qualifications of independent professional engineer responsible for construction certification

______________ 2. Identity and qualifications of the person or persons responsible for overseeing the QA/QC program

______________ 3. Identity and qualifications of installers of groundwater protection, final cover systems, or other components

______________ 4. Testing and monitoring protocols including checklists of testing requirement for each landfill component

______________ 5. Discussion of how construction QC inspections will be performed

______________ 6. Location, availability, applicability and calibration of test facilities and equipment, both field and lab

______________ 7. Procedure for observing and testing the borrow source, soil liner and membrane liner

______________ 8. Procedures for reviewing inspection test results and laboratory field sampling and testing results

______________ 9. Actions to be taken to repair or replace the liner or cap should deficiencies in liner or cap construction be identified, including who is to be notified and in what manner

______________ 10. Reporting procedures for all inspection and testing data

E. Design and Construction Technical Specifications

The Design and Construction Technical Specifications shall include the requirements for materials selection and testing and provide specific and comprehensive construction methods requirements for materials placement for all landfill components. The technical specifications shall include, but not be limited to:

_______________ 1. Ground water protection systems

_______________ 2. Environmental monitoring systems

_______________ 3. Final cover systems

_______________ 4. Storm water control

_______________ 5. Erosion control during construction

_______________ 6. Construction worker safety and health

III. OPERATION and MAINTENANCE PLAN

The purpose of the Operation and Maintenance Plan is to describe methods, techniques and equipment that will be necessary to properly operate the landfill in compliance with the regulations. The O&M plan consists, in part, of a narrative of the methods and schedule of landfilling activities and the proposed engineering techniques and major types of equipment to be used in landfilling activities.

A. General

The narrative should include a description of the procedures and practices for operation, use and maintenance of all components of the landfill including:

________________ 1. Ditches, swales, detention basins and other drainage controls

________________ 2. Borrow pits, soil storage and handling areas and structures

________________ 3. Scales and weigh station if required

________________ 4. Water and air pollution control facilities

________________ 5. Equipment storage and maintenance buildings, and other buildings

________________ 6. Access roads

________________ 7. Facility security

________________ 8. Groundwater, surface water and gas monitoring systems

________________ 9. Equipment

11. Waste handling and covering, which shall include:

________________ a. Unloading, spreading, compacting and covering operations

________________ b. The frequencies of placement of daily, intermediate and final cover

________________ c. Cover materials to be utilized, including estimated volumes required (show daily, intermediate, and final cover calculations) and their sources and availability

________________ 12. Storm water, soil erosion, and sedimentation control

________________ 13. Gas monitoring and control of the migration of explosive gasses

________________ 14. Control of vectors

________________ 15. The structures and procedures to be used in controlling and collecting blowing litter

________________ 16. Dust control measures to be taken and when they would be implemented

________________ 17. Bird hazard control measures

________________ 18. Cell, lift and phase development

________________ 19. Special waste handling

B. Waste Control

________________ 1. Operating procedures for complying with wastes banned pursuant to 310 CMR 19.017, Waste Control

C. Leachate Management Plan

________________ 1. Leachate collection and transportation system clean-out and maintenance

________________ 2. Treatment facility maintenance

________________ 3. Holding tanks inspection and maintenance

________________ 4. Leachate disposal contracts

D. Staffing

A staffing plan shall be included which indicates the number of personnel required to operate the facility, taking into consideration:

________________ 1. The type of facility

________________ 2. The size of the facility

________________ 3. The safety requirements of the facility

________________ 4. The past history and present operation of the facility

_______________ 5. The scope of the proposed operation

_______________ 6. The number of operational days per week

_______________ 7. The number of operational hours per day

_______________ 8. The number of shifts per day, if applicable

_______________ 9. The required number of personnel per day or shift

_______________ 10. Emergency personnel coverage of operations

_______________ 11. Activities which would require specially trained personnel

E. Inspection & Maintenance

An inspection and maintenance plan shall be included which shall include, at a minimum, a written schedule for regular inspection and reporting of:

_______________ 1. Landfill operations

_______________ 2. Environmental monitoring systems

_______________ 3. Environmental control systems including operational and structural equipment such as scales, dikes, berms, pumps, leachate collection systems and on-site treatment systems

_______________ 4. All slopes, elevations and remaining capacity

F. Safety

A facility safety plan shall be included which explains the emergency procedures, hazard prevention procedures and emergency equipment to be available, and from where such aid and equipment will come in the event of a fire, explosion or release of materials to the air, water or soil of the Commonwealth that could threaten public health, safety or the environment. The facility safety plan for a landfill should include:

_______________ 1. Fire control plan

_______________ a. Certified by local fire department or independent licensed fire consultant

________________ 2. Hazardous waste contingency plan

________________ a. Inspection, detection and exclusion of hazardous waste

________________ 3. Accident prevention and safety

________________ 4. Hot loads

________________ 5. Spills of oil or other hazardous material

________________ 6. Explosions

G. Environmental monitoring

An environmental monitoring plan that includes:

________________ 1. A surface and ground water sampling and analysis plan, based upon the results of the hydrogeological study specified in 310 CMR 19.105(4), which will ensure the accurate representation of surface and ground water quality at the upgradient and downgradient sampling points. At a minimum, this plan shall address:

________________ a. sample collection

________________ b. sample preservation and shipment

________________ c. analytical procedures

________________ d. chain of custody control

________________ e. analytical QA/QC

________________ 2. An air monitoring plan which established the frequency and extent of sampling and analysis for explosive gasses and air quality

H. Recycling Plan

________________ 1. Tracking and reporting system to verify compliance with recycling requirements

IV. CONCEPTUAL CLOSURE and POST-CLOSURE PLAN

The purpose of the closure and post-closure is to indicate how the landfill, or phases of the landfill, will be closed, when each phase will close, and the schedule for post-closure maintenance and monitoring activities. The plan should also address the landfill assessment requirements and any post-closure uses planned for the facility.

Information concerning closure activities should include:

_______________ 1. Narrative description of activities necessary to close, cap and secure the landfill at any point during its operating life

_______________ 2. A schedule for completion and closure of each phase of the landfill where landfill development is to proceed by a phased development, or for completion and closure of the entire landfill

_______________ 3. The closure elevation of each phase of the landfill

_______________ 4. An estimate of the final closure date for the entire facility

_______________ 5. A description of how the cap on adjoining phases will be tied together

_______________ 6. Cost estimate for closure including projection of cost to proposed closure date

_______________ 7. Landfill assessment requirements. Proposed schedule and method of completing the initial site assessment, comprehensive site assessment, corrective action analysis and corrective action design (final closure plans)

_______________ 8. Post-closure inspections, monitoring and maintenance of:

_______________ a. Final cover including erosion, settlement, and corrective action

_______________ b. Leachate collection system

_______________ c. Environmental monitoring system

_______________ d. gas control system

_______________ 9. Post closure funding

________________ 10. Reporting requirements

a. Minimum every two years

APPENDIX C. OUTLINE FOR SOLID WASTE SITE ASSESSMENT

USE OF THIS GUIDANCE DOCUMENT: This guidance document should be used to develop a site-specific framework to fully characterize a solid waste landfill. This guidance outlines specific technical requirements and is intended to amplify the regulatory requirements cited in the Massachusetts Solid Waste Management Facility Regulations, Chapter 310 CMR 19.00 Section 150. A landfill assessment must summarize the site history, determine the lateral and vertical extent of refuse in the landfill and evaluate its existing and potential impact on human health and the environment. An assessment must be conducted in three steps as described below.

SOLID WASTE LANDFILL ASSESSMENT PROCESS

Landfill assessments must be conducted in three phases;

I. Initial Site Assessment (**ISA**). Existing historical and descriptive information is collected and a scope of work for the second phase, Comprehensive Site Assessment is prepared. Two copies of an ISA summary report are submitted to DEP for review and approval.

2. Comprehensive Site Assessment (**CSA**). Environmental data are collected, interpreted and evaluated to qualitatively assess the risk posed to the environment and human health. A quantitative risk assessment must be conducted only when necessary. Two copies of the CSA report must be submitted to the Department for review and approval. Following DEP's approval of the completed CSA, a scope of work for the third assessment phase, Corrective Action Alternatives Analysis, must be developed and submitted to the Department.

3. Corrective Action Alternatives Analysis (**CAAA**). The feasibility of implementing a range of alternatives for site closure is determined. A standard cap alternative as described in 310 CMR 19.112 must be developed to serve as a basis for comparison.

SCOPE OF WORK OUTLINE FOR ISA

TASK 1.1. BACKGROUND INFORMATION

Provide the following information on the site:

A) Owner, address, locus on map, and UTM coordinates,

B) Site status (whether active or inactive),

C) Acreage,

D) Abutting property owners and land uses.

TASK 1.2. HISTORICAL RESEARCH

Complete attached Preliminary Assessment Form, and provide the following information on the site:

A) Towns and haulers that disposed waste at the landfill;
  1. Industries located in these towns or serviced by the haulers.
  2. Waste streams and amounts.

B) Past operational practices
  1. Start of operations.
  2. Disposal method.

TASK 1.3. LITERATURE/DATA SEARCH

Complete a literature and data search.

A) List all existing reports and data compilations;

B) Review DEP and Town files;

C) Interview site workers;

D) Review relevant USGS data;

E) Identify potential environmental and public health sensitive receptors;

F) Evaluate the quality of the existing monitoring wells and present the criteria used to evaluate them;

G) Summarize and evaluate the above and all other existing data.

TASK 1.4. HYDROGEOLOGICAL DESCRIPTION

A) Describe the site (local)

1. Surficial geology,
2. Bedrock geology,
3. Hydrology.

B) Describe the regional

1. Surficial geology,
2. Bedrock geology,
3. Hydrology.

C) Submit one legible copy of each of the following with the site properly located:

1. USGS surficial geology map,
2. USGS bedrock geology map.

TASK 1.5. SITE VISIT

Conduct a site visit and document field observations, which should include but not be limited to:

1. Condition of landfill surface/cap,
2. Direction(s) of surface water run-off,
3. Location and condition of all monitoring devices,
4. Evidence of leachate breakouts,
5. Evidence of landfill gas emissions,
6. Location and condition of surface water and wetlands,
7. Landfill operation procedures,
8. Land use of adjacent properties,
9. Landfill accessibility,
10. Local geology.

TASK 1.6. MAPPING

A) Provide an up-to-date base map. The scale of the map must be between 1" to 40′ and 1" to 100′. The following features must be shown:

1. Site topography,
2. Property boundaries,
3. Plan approved area,
4. Extent of refuse, if unknown the extent of refuse must be determined during the CSA,
5. All existing monitoring wells, test pits, surface water, and soil sampling locations,
6. On and within 500 feet of the landfill, identify:
    - (a) Wetlands and floodplains,

(b) Existing buildings and/or man made structures, utilities, etc.,
(c) Items identified in Task 1.6(B) below.

B) Provide an up-to-date regional locus map, on a USGS topographic map or legible copy. Within one mile of the site, identify the following features:

1. Public and private water supplies,
2. Zone IIs,
3. Interim Wellhead Protection Areas (IWPAs),
4. Watersheds and their drainage patterns,
5. Aquifer protection zones,
6. Areas of Critical Environmental Concern,
7. Surface water bodies.

TASK 1.7. FIELD SCREENING (OPTIONAL)

The DEP recommends the use of non-destructive geophysical methods and soil gas screening methods during the ISA to help characterize subsurface geologic conditions, extent of refuse and leachate plume. Though the DEP does not require that field screening methods be conducted at all sites during ISA, DEP does however, recommend that applicable screening tools be utilized to minimize field investigation costs during the subsequent CSA.

If field screening activities are to be performed, a proposal must be submitted to the DEP for review and approval prior to implementation. The proposal must contain project goals, field procedures, instrumentation, documentation of calibration methods and project deliverables.

TASK 1.8. DEVELOPMENT OF CSA SCOPE OF WORK

Prepare a draft scope of work for the CSA based on the results of the ISA. Use the guidelines provided in the following section, Tasks 2.1 - 2.8. This draft scope of work should be appended to the ISA report.

A project schedule must be developed for each phase of the assessment. This schedule must include estimated start and completion dates for the overall project and for each task. An estimate of resources required -- staff and subcontractors -- must also be provided.

ISA APPROVAL

Before CSA work is initiated, the DEP will review and approve (with conditions as necessary), the ISA report and the scope of work for the CSA.

A letter of approval will be issued to the landfill owner/operator.

CSA SCOPE OF WORK OUTLINE

TASK 2.1. ISA SUMMARY

Provide a brief summary of prior data on the landfill, and any analyses of those data used to develop the scope of work. Completion of this important task shows DEP how ISA information will be put to work in conducting the CSA.

TASK 2.2. MAPPING

All features mapped in Task 1.6 of the ISA should be updated during the CSA as additional data on site conditions are gathered. The updated base map should indicate the location of all proposed sampling points as required below.

TASK 2.3. DRILLING PROGRAM

A) Submit a plan for a drilling program which includes:

1. The rationale for the choice of location, depth, and number of boreholes, monitoring wells, piezometers installed and associated samples collected,
2. Locus map indicating the proposed locations listed above,
3. Drilling method(s) and field procedures,
4. Copy of standard boring log,
5. Soil sampling method(s),
6. Soil classification system,
7. Bore hole abandonment procedures,
8. Drilling QA/QC plan, which includes:
    - (a) Well logs, both driller's and consultant's,
    - (b) As built monitoring well, piezometer designs,
    - (c) Equipment decontamination procedures,
    - (d) Grout mix ratios.

NOTE 1: The number and location of the monitoring wells must be sufficient to adequately describe the site hydrogeology.
NOTE 2: Well couplets are required.

TASK 2.4. DETERMINATION OF HYDRAULIC CONDUCTIVITY

The hydraulic conductivity of all major stratigraphic units must be determined. The method(s) used to collect and interpret data must be described in detail in the scope of work.

TASK 2.5. SAMPLING AND ANALYSIS PLAN

Prepare a sampling and analysis plan to determine the level and extent of contamination present. The plan should include sampling and analysis procedures consistent with EPA protocol for the following media and parameters at a minimum:

A) Samples of public drinking water, private drinking water, surface water, groundwater and leachate:

1. Parameters required for **routine landfill monitoring;**

    (a) Inorganics (Arsenic, Barium, Cadmium, Chromium, Copper, Cyanide, Lead, Mercury, Selenium, Silver and Zinc),
    (b) Manganese,
    (c) Iron,
    (d) Chlorides,
    (e) Sulfate,
    (f) Nitrate - as Nitrogen
    (g) Total Dissolved Solids,
    (h) Alkalinity,
    (i) BOD and COD,
    (k) Ph, Specific Conductance, Temperature and Dissolved Oxygen (measured in the field),
    (j) Purgeable volatile organic compounds including acetone, methyl ethyl ketone, methyl isobutyl ketone and xylenes (measured using EPA Method 624, as amended).

2. Parameters **based upon results of ISA;**

    (a) Pesticides,
    (b) PCB's,
    (c) Base/Neutral and Acid Extractable Compounds,
    (d) PAH's,
    (e) Halogenated Volatile Organic Compounds,
    (f) Coliform,
    (g) TPH,
    (h) 2,3,7,8-TCDD (indicator for Dioxins and Furans)

B) Parameters used to establish soil and sediment quality **based upon results of ISA or CSA;**

(a) Total metals,
(b) Pesticides,
(c) Volatile organic compounds,
(d) PCB's,
(e) Base/Neutral and Acid Extractable Compounds,
(f) PAH's,
(g) Halogenated Volatile Organic Compounds,
(h) TPH,
(i) 2,3,7,8-TCDD (indicator for Dioxins and Furans).

C) Parameters Required to Establish Air Quality

(a) Methane,
(b) VOC quantities and types,
(c) Hydrogen Sulfide,
(d) % LEL,
(e) % Oxygen,
(f) Total Non-methane Organic Compounds (NMOCs).

NOTE 1: Parameters (except those listed in 2.5 A) 1.) to be included in monitoring program may be modified if ISA or CSA indicate their likely presence or absence.
NOTE 2: First round only - Water samples may be analyzed for total metals. If the results indicate presence of metals above Maximum Contaminant Level (MCL), the following round should be field filtered and analyzed for dissolved metals. If results are below MCL, continue with total metals analysis.
NOTE 3: Surface and Ground water samples - Quarterly samples should be collected from each monitoring well and analyzed for the parameters listed in the approved scope of work. This sampling program should continue for at least one year, to establish existing and background quality, at which time it may be amended based on the results obtained.
NOTE 4: Samples collected from public and private water supply wells should be analyzed using EPA 500 series methods, unless significant levels of contamination are suspected.
NOTE 5: Surface water samples should not be taken within 48 hours after a precipitation event.
NOTE 6: The location of all sampling points must be shown on the base map prepared in Task 2.3.(A).
NOTE 7: Soil and sediment sampling may not be required if results of ISA do not indicate a concern.
NOTE 8: Total NMOC emission testing is required by EPA to determine if active gas controls should be installed.
NOTE 9: As gas generation and gas pressure are affected by

the time of day, season, temperature, precipitation, and barometric pressure, these variables should be recorded and reported.

D) Prepare a field QA/QC sampling plan to include:

1. Sample collection method(s),
2. Containers used,
3. Sample preservation techniques,
4. Equipment decontamination procedures,
5. Field blanks,
6. Equipment blanks,
7. Trip blanks,
8. Duplicates,
9. Chain of custody procedures,
10. Field log book.

E) Prepare a Lab QA/QC plan to include:

1. Lab blanks,
2. Duplicates,
3. Allowable holding times,
4. Spiked samples,
5. Chain of custody procedures.

NOTE 1: Laboratory data sheets must be submitted as part of the assessment report. For all samples analyzed, these data sheets must include: date of sample collection, arrival at lab, analysis, and extraction, (if applicable). These data sheets must also include detection limits, analytical method, signature of person who performed analysis and reason for any necessary deviation from approved procedures.

NOTE 2: Samples must be analyzed within proper holding times.

NOTE 3: A State certified lab must perform analysis.

NOTE 4: Data sheets for all blanks and duplicates run must be submitted.

TASK 2.6. HEALTH AND SAFETY PLAN

A) Prepare a health and safety plan which includes:

1. Purpose,
2. Applicability,
3. Responsibilities of Safety Officer,
4. Name of the Safety Officer,
5. Site information,
6. Known hazards,
7. Site controls,
8. Level(s) of personnel protection required,
9. Personnel decontamination area,
10. Personnel decontamination procedures,

11. Emergency telephone numbers and addresses:
    (a) Fire, (b) Police, e) Ambulance
    (c) Rescue, (d) Hospital,
12. Location of the nearest telephone,
13. Directions to nearest hospital.

TASK 2.7. PROJECT SCHEDULE

A project schedule must be developed for each phase of the assessment. This schedule must include estimated start and completion dates for the overall project and for each task. An estimate of resources required -- staff and subcontractors -- must also be provided.

TASK 2.8. DRAFT CSA REPORT SUBMITTAL

Upon completion of the tasks in the approved scope of work, prepare a draft report summarizing the results of the CSA activities. The report should include the following information:

A) DATA INTERPRETATIONS AND PRESENTATIONS

1. Evaluation of ground and surface water quality on-site with respect to background quality,
2. Evaluation of site hydrogeology with respect to local geology,
3. Identification of possible surface water flow paths,
4. Interpretation of geologic stratigraphy,
5. Interpretation of trends observed in piezometric and analytical data,
6. Calculation of mass water balance to determine potential volumes of leachate and surface water runoff,
7. Calculation of hydraulic conductivities,
8. Evaluation of soil gas and air quality,
9. Identification of toxic air contaminants, on-site and off-site, realtive to ambient air,
10. Identification of possible gas-flow paths,
11. Recommendations for additional CSA work.

B) MAPS, PLANS AND FIGURES

1. Locus map,
2. Site plan; scale between 1" to 40′ and 1′ to 100′
3. Bedrock contour map,
4. Geologic cross-sections; minimum of two at right angles.
5. Compilation of water table and piezometric data on site maps contoured to indicate equipotential and flow lines for both seasonal high and low groundwater elevations. Vertical equipotential and flow lines should be shown on geologic cross-sections for both seasonal high and low groundwater elevations,

6. Survey all new monitoring wells, test pits, and surface water, soil and air sampling locations utilized during the CSA and indicate their location on an updated site map.

C) SUMMARIES, TABLES AND FORMS

1. Geologic logs of all borings and test pits,
2. Tabulation of all soil boring, piezometer and monitoring well construction data,
3. As built design schematics for all monitoring wells,
4. Tabulation of all analytical and field screening data,
5. Tabulation of all water table and piezometric elevation data,
6. Table of hydraulic conductivity test results,
7. Summary of all geophysical results,

D) BASELINE RISK ASSESSMENT

1. Identification of potential human and environmental sensitive receptors (From Initial Site Assessment),
2. Summary of contaminants and levels of contamination (from sampling program). Any contamination exceeding Maximum Contaminant Levels (MCLs) must be highlighted.
3. Summary of all pathways (in ground or surface water, soil or air) by which existing contamination may reach identified public health or environmental sensitive receptors.
4. A recommendation for a quantitative risk assessment, as appropriate.

Upon submittal of the draft CSA report, DEP will review and approve (with conditions for recommended additional work as necessary), the CSA draft report. A letter of approval will be submitted to the landfill owner/operator.

FINAL CSA REPORT SUBMITTAL

Upon DEP acceptance of the draft CSA report, all approved recommendations for additional work should be carried out. Field investigation work may utilize methodologies previously approved in the CSA scope of work. Any new methodologies to be used must be submitted to DEP for approval. Upon completion of additional recommended work a final CSA report must be prepared and submitted to DEP. The final report must include a scope of work for a Corrective Action Alternatives Analysis. Two copies of the final report must be submitted to DEP for review and approval.

CAAA SCOPE OF WORK OUTLINE

Following the completion of the baseline risk assessment and submittal and approval of the CSA report, a number of closure and corrective action options must be developed in a three-step Corrective Action Alternatives Analysis (CAAA) process. First appropriate technologies are listed, second these technologies are screened, and finally, screened technologies are combined into option packages. These option packages, one of which must be a standard cap, are then analyzed according to specific criteria listed below, and one is recommended. Based on this analysis and recommendation, DEP will select an option to be implemented. Before CAAA work is initiated, the DEP must review and approve (with conditions as necessary), the scope of work.

TASK 3.1. DEVELOPMENT OF CORRECTIVE ACTION ALTERNATIVES:

A) Develop a list of potential closure and corrective action technologies applicable to site-specific conditions determined during the ISA and CSA. The list should comprise all technologies which may be appropriate to address existing contamination. Technologies relevant to each effected environmental media at the site (air, ground water, surface water, leachate, wetlands, soils) must be listed.

B) Screen list of technologies to determine which technologies are truly appropriate for the site. In screening technologies, consider these questions:

1. Will the technology address the existing level and extent of contamination in the relevant media?
2. Can the technology be combined effectively with other appropriate technologies without adverse effects?

C) Integrate successfully screened technologies into several closure and corrective action alternatives.

TASK 3.2. DETAILED ANALYSIS OF CORRECTIVE ACTION ALTERNATIVES:

For each alternative, apply these selection criteria:

A) Overall protectiveness - risk reduction

B) Ability to comply with all state and federal environmental laws and local zoning considerations. C. Long and short term effectiveness by evaluating:

1. Reliability
2. Permanence
3. Useful Life
4. Adverse and Beneficial Effects

D) Ability to reduce contaminant toxicity and volume,

E) Implementability by evaluating;

1. Technical feasibility,
2. Availability,
3. Demonstrated performance,
4. Support and installation requirements,
5. Time to implement,
6. Safety,
7. Operation and maintenance (including monitoring of short and long-term performance).

Once the selection criteria listed above have been applied to each alternative, two weighing factors must be considered:

A) Cost,
B) Community Acceptance.

These final criteria should be used to eliminate alternatives which may otherwise have been acceptable but are not realistic due to financial and political constraints.

FINAL CAAA REPORT APPROVAL

Once the tasks in the DEP approved scope of work are completed, a draft report summarizing the results of the CAAA activities, including a recommendation for an alternative to be implemented, must be prepared. The Department will review the CAAA draft and issue a letter of approval, with conditions as appropriate, to the landfill owner/operator. Two copies of the final CAAA report which address all DEP conditions must then be prepared and submitted for review and approval. DEP will then select a closure and corrective action option as appropriate to be implemented.

APPENDIX D. SUPERFUND LANDFILL SUMMARY TABLE

NAME	ACRES	YRS. OPER.	LANDFILL CONDITION	WASTE ACCEPTED	THREATS POSED	REMEDIAL ACTION	COST* ($ MILL.)
Wildcat Landfill, Delaware	44	11	Unlined. Uncapped.	Latex paints. Sludges.	PDW(500 ft. DG). High GWC BLB.	Clayey soil cap.	7.5
Helva Landfill, PA	20	14	Unlined. Eroded soil cover. Leachate and surface water flow to on-site ponds.	High volume TCE liquid waste dumping from local industry.	PDW/RDW CONT. High GWC BLB.	GWR. RCRA comp. cap. AWS.	40.2
Volney Landfill, NY	55	14	40% covered by FML. Unlined. Leachate to WWTP.	50 to 200 drums of unidentified liquid waste discovered.	RDW(1 mile DG). Low GWC BLB.	Improve leachate collection system. FML cap.	12.8
Strasberg Landfill, PA	22	4	20 mil PVC cover topped with two ft. cover material. 20 mil PVC liner. LC to OST. SWC to impoundment.	1000 cubic yard industrial PVC waste. 35,000 gallons heavy metal sludge.	RDW CONT. Low GWC BLB.	LC to RCRA facility. AWS. Point-of-use carbon system for residents.	0.3
Combe Landfill, North, NJ	65	23	Unlined. Uncapped	No documented waste dumping.	PDW(2 miles DG). Low GWC BLB.	Clay Cap.	12.1
Florence Landfill, NJ	29	8	Unlined. Uncapped. LC to surface water body.	95 tons of HW - phthlates, heavy metals, vinyl choride monomer.	RDW CONT. Low GWC BLB.	LC to WWTP. RCRA composite cap. Circumferential slurry wall. Passive gas collection/ carbon treatment. GW interceptor diversion trench.	9.3
Winthrop Landfill, ME	20	52	Unlined. Uncapped.	20 years of chem. waste dumping. Chemical waste burning. 3 million gallons solvent/chem. dump.	RDW CONT. High GWC BLB.	GWR to air strip/ carbon. Partial cutoff slurry wall. AWS. Clay cap.	7.4
Old Bethpage LF, NY	65	28	Unlined. 45% clay capped. LC to sewer after metals removal. Active energy prod. gas emission system.	None documented.	PDW(1 mile DG). Low GWC BLB.	Clay cap entire LF. Improve LC system and gas emission control system.	23.1
Beacon Hts. LF, CONN	30	69	Unlined. Uncapped.	Industrial chemical sludges. Open burning of non-combustibles.	RDW CONT(100 ft. DG). High GWC BLB.	LC to OST. RCRA composite cap. AWS.	19.6
Combe Fill South, NJ	65	40	Unlined. Uncapped. LC to impoundment.	Chemicals. Waste oil. Paints. Dyes.	RDW CONT(1 mile DG). PDW (1mile DG). Low GWC BLB.	GWR. Active flare gas gas collection. Clay cap. AWS	52.2

NAME	ACRES	YRS. OPER.	LANDFILL CONDITION	WASTE ACCEPTED	THREATS POSED	REMEDIAL ACTION	COST* ($ MILL.)
Sharkey LF, NJ	90	36	Unlined. Uncapped.	Ciba-Giegy dumped 753,000 lbs. of HW. Cesspool waste from local treatment plant.	PDW (2 mile DG). Low GWC BLB.	GWR to airstripper. Clay cap.	25.9
Moyer LF, PA	39	40	Unlined. Uncapped. LC to onsite lagoons.	PCBs, solvents, low-level radioactive waste.	22 RDW border LF. Low GWC BLB.	Modify LC system to OST. Energy prod. from gas collection. Soil Cap.	
Tybouts LF, DE	51	3	Unlined. Uncapped.	Chlorinated Sol.	RDW CONT(border LF). PDW (1.5 miles DG). High GWC BLB.	Excavate/consolidate landfill. Composite cap. LC trench. GWR and treatment.	35.8 to 69.0
GEMS LF, NJ	60	40	Unlined. Uncapped.	Solvents. Various chemical wastes. DDT/DDD sludge.	RDW (border LF). PDW (1 mile DG). High GWC BLB.	Soil/Multimedia cap. GWR with airstrip/carbon treat. Active gas collection/ carbon treatment/ flaring.	28.1
Helen Kramer LF, NJ	66	27	Unlined. Uncapped.	Alledged waste.	RDW CONT. High GWC BLB.	Clay Cap. GWR(trench). Treatment undecided. Dewater, excavate, and fill lagoons.	41.7
Lipari LF NJ	6	23	Unlined. FML cap.* Slurry wall.* (*part of earlier EPA remediation)	Chemicals, cleaning solvents, drums.	Surficial contact with LF sediments. High GWC BLB.	Drainage ditch. Dredge/dewater sediments incinerate and dispose. GWR.	21.0
Auburn Rd. LF, NH	12	16	Unlined. Uncapped.	1900 unidentified drums found. Septic waste.	RDW CONT.(200 ft. DG) High GWC BLB.	FML cap. GWR well/trench. GW treat with metal removal, stripping, carbon treatment. Extension of water line.	22.1
Old Springfield LF, VT	27	21	Unlined. Capped with sand and glacial till.	Semi-liquid or liquid waste dumped in trenches.	RDW (above LF). Trailer park on top of landfill. High GWC BLB.	GWR to WWTP.	5.4
Laurel Park LF, CN	19	47	Unlined. Uncapped.	Chemical spills.	RDW CONT(0.5 miles DG). High GWC BLB.	GWR well/trench to WWTP. Composite cap.	21.7
Landfill& Resource Recovery,RI	28	52	Unlined. 80% FML cap. Passive vent.	Hazardous materials mixed with municipal waste.	RDW CONT(1200 ft. DG). Low GWC BLB.	Completed and upgraded FML cap. Switched to active gas collection treatment.	5.1

LIST OF ABBREVIATIONS

AWS = alternate water supply
BLB = beyond landfill boundary
CONT= contaminted
FML = flexible membrane liner
GWC = ground water contamination
GWR = ground water recovery
LC = leachate collection
OST = on-site treatment
PVC = poly vinyl chloride
PDW = public drinking supply
RDW = residential drinking well
SWC = surface water collecti
WWTP= waste water treatment plant
* Net Present Worth (30 years/ 10% interest)

APPENDIX E. MODEL REQUEST FOR PROPOSALS

I. INTRODUCTION

General Information

The purpose of this document is to request proposals for the award of consulting services by a qualified firm with background and experience in conducting landfill assessments related to closure of municipal solid waste landfills.

This initial site assessment will be conducted to fully characterize the municipal landfill for the town of *****. The purpose of the site assessment is to investigate the site history, determine the lateral and vertical extent of refuse, determine the extent of contamination, and to determine the existing and potential impact on human health and the environment based on site visits, and existing data and studies of the site.

This RFP/RFQ is issued by Town of ***** and should be addressed to:

Board of Health
Address
*****, MA Zip

One original and 6 copies of the proposal must be submitted on or before 4:00 P.M. *****. Said submittal shall be submitted to the above noted issuing office. No proposals, amendments, or supplements will be accepted after the submission deadline, unless specified by the Board of Health.

The proposed contract will be in force for a period not to exceed **** (**) days once properly signed and executed. The Town of ***** reserves the right to issue extensions to this contract, only and if mutually negotiated at a reasonable time prior to the date of expiration.

II. PROPOSALS

A. Format

Respondents shall submit a complete proposal to this RFP/RFQ using the format provided in Attachment A (Appendix C of the Guidance Manual). Proposals failing to adhere to the prescribed format may be ruled non-responsive and disqualified. The proposal shall be typewritten (double spacing) with pages numbered and signed in ink by an official authorized to bind the company to its provisions. The proposal must include a statement that the prices quoted remain valid for at least (90) days from the due date for proposals to this RFP. The contents of this RFP and the proposals will become contractual obligations, if a contract ensues.

Proposals should be prepared simply and economically, providing a concise description of the responder's ability to meet the requirements of the RFP. All proposals and materials submitted will be considered the property of the Town of *****.

B. Evaluation

The contract will be awarded to the responder best satisfying the overall requirements of the RFP but not necessarily quoting the lowest price. The Town of ***** will use the following process to evaluate the proposal:

Step 1: Initial Screening

An initial screening of all proposals will be conducted by the Board of Health of the Town of *****. The sole purpose of this step is to determine a proposal's overall completeness and responsiveness. The Town reserves the right to disqualify proposals which are determined to be incomplete or non-responsive.

Step 2: Management and Technical Experience and Capabilities Evaluation

The evaluation of management, technical qualifications and experience will include, but not be limited to the management capabilities and approach reflected in the proposal and demonstrated in prior projects, past performance record, levels of resources and type and extent of expertise available to the project, and capacity of the firm to perform in the requisite time. Based on this evaluation, the proposals will be ranked on merit. The Department may require the top ranked proposers to appear for interviews as part of this step of the evaluation.

Step 3: Cost Evaluation

The proposal will be evaluated on overall price and ranked form least costly to most costly based on the projected levels of effort and costs provided in this component. Proposals must present the cost for conducting each task required under Attachment A. Proposals should include both direct and indirect costs.

Step 4: Selection of a Contractor:

The results of Steps 2 & 3 of each proposal will be compared by the Town at this step and a final ranking shall be made considering both management and technical merit and capability and cost. The purpose of the comparison at this step of the evaluation will be to determine if the ranking of proposals as to cost should alter the merit ranking of the proposals. In making such a judgement the Town will primarily consider the need to provide a comprehensive array of specialized services to accomplish the project described in the RFP/RFQ, including the need for detailed knowledge of the Town's solid waste program, policies and procedures. The overall goal of the evaluation process shall be to recommend award for the contract to the proposal which meets the requirements of the RFP and is at the same time cost-effective.

All proposals must include a completed Certificate of Non-Collusion (Attachment C), proof that the consultant is insured and can obtain a performance bond.

If after completing this evaluation, the Town finds that two or more proposals are more or less equal, it reserves the right to re-evaluate said proposals placing greater emphasis on any and all of the following factors:

1) Price
2) Past performance record
3) Firm's special experience or abilities
4) Capacity of the firm to accomplish the work
5) Size and availability of firm personnel
6) Other criteria related to the firms ability.

III. PRIME CONTRACTOR RESPONSIBILITIES

A. Subcontracting

The prime contractor will be required to assume responsibility for all services offered in the proposal whether or not the prime contractor produces them. The Town will consider the prime contractor to be sole point of contact with regard to contractual charges resulting from the contract. If any part of the work is subcontracted, the prime contractor must provide a complete description of work subcontracted and descriptive information about subcontractor's organization and capabilities. The prime contractor is solely responsible for timely adherence to by a subcontractor to all provisions of the contract. The prime contractor is solely responsible for all subcontractor arrangements.

B. Reporting Requirements Schedule

Reporting requirements for project assignments entered into as the result of this RFP/RFQ will be mutually agreed upon. Responders will be advised that the Town requires monthly contract status reports and more frequent project-specific progress reports, as deemed necessary, as well as any other reports, appraisals, changes notices etc.

IV.ATTACHMENTS

A. Scope of Services

The Scope of Services provides a detailed outline of activities which need to be conducted for the initial site assessment process to be completed under this RFP.

B. Technical Evaluation Criteria

The technical evaluation criteria sheet is used to group consultants based on their ability to perform the required services. It provides criteria from which to rate proposals as unacceptable based on a minimum level of competence, and advantageous and highly advantageous based on experience in performing the tasks required for landfill assessment and closure.

C. Certificate of Non-Collusion

All proposals must include the completed certificate of non-collusion.

ATTACHMENT B: TECHNICAL EVALUATION CRITERIA

CRITERIA 1. Completeness

MINIMUMS Complete response to RFP

COMPARATIVE ADVANTAGEOUS N/A
HIGHLY ADVANTAGEOUS N/A

CRITERIA 2. Conformance to Technical and Scheduling Requirements

MINIMUMS Full Conformance

COMPARATIVE ADVANTAGEOUS N/A
HIGHLY ADVANTAGEOUS N/A

CRITERIA 3. Proposed Service
a) Ability to provide requested service

MINIMUMS
Proposal shows that consultant has the capacity to provide the required services.

COMPARATIVE ADVANTAGEOUS
Proposal shows that consultant has an established relationship with all sub-contractors of at least 2 years.

HIGHLY ADVANTAGEOUS
Proposal shows consultant has the ability to provide established services without sub-contracting and/or has an established relationship of more than three years.

CRITERIA 3. Proposed Service
b) Experience in Assessment and Closure services

MINIMUMS
Proposal shows consultant has satisfactorily conducted at least one landfill or waste site assessment and closure which included a groundwater and gas monitoring program.

COMPARATIVE ADVANTAGEOUS
Proposal shows consultant has satisfactorily conducted at least one landfill or waste site assessment and closure under the DEP DSWM or BWSC guidance.

HIGHLY ADVANTAGEOUS
Proposal shows consultant has satisfactorily completed more than three assessment and closures assessment using Department guidance.

CRITERIA 4. Timing

MINIMUMS
The consultant's proposal must fall within 3 months of the proposed schedule.

COMPARATIVE ADVANTAGEOUS N/A
HIGHLY ADVANTAGEOUS N/A

CRITERIA 5. Staffing
a) Availability

MINIMUMS
The consultant has the necessary staff to perform the required services.

COMPARATIVE ADVANTAGEOUS
The consultant has the necessary staff dedicated to perform the required services.

HIGHLY ADVANTAGEOUS
The consultant has the necessary staff dedicated & designated back-up staff to perform the required services.

CRITERIA 5. Staffing
b) Experience

MINIMUMS
The consultant's project manager has a minimum of 2 years of site assessment and closure experience

COMPARATIVE ADVANTAGEOUS
The Consultant's project manager has more than two year's site assessment and closure experience and 50% of support staff has one year's site assessment and closure experience.

HIGHLY ADVANTAGEOUS
Project manager has a minimum of 4 years of site assessment and closure experience, and 50% of the support staff has more than 2 years assessment and closure experience.

ATTACHMENT C:

CERTIFICATE OF NON-COLLUSION

The undersigned certifies under penalties of perjury that this bid or proposal has been made and submitted in good faith and without collusion or fraud with any other person. As used in this certification, the word "person" shall mean any natural person, business, partnership, corporation, union, committee, club, or other organization, entity or group of individuals.

Name of person signing bid or proposal

Name of Business

APPENDIX F. MUNICIPAL FEE PROGRAMS

Following are two lists of trash fees from municipalities responding to a Massachusetts Municipal Association survey on trash collection fees. The first lists municipalities that have started a curbside pick up or per bag fee, the second lists landfill/transfer station sticker fees. If you wish to get more information on a specific municipality's program, contact the MMA Membership Services Division for documents or contact people.

RESIDENTIAL TRASH FEES IN MASSACHUSETTS 1990

MUNICIPALITY	POP	METHOD	FEE STRUCTURE	FEE RATE
Amherst	33,229	curbside	graduated rate	$105/one 30 gal barrel/wk;$140\two 30 gal barrels/wk
Ashburnham	5,020	curbside	sticker on bag	$1/sticker;attach to bag, or on top of loose trash in barrel
Brockton	100,000	curbside	flat rate	$27.50/household/ quarterly
Chelmsford	32,000	curbside	flat rate plus	$95/household/yr plus sticker: $1.75 for sticker on each bag
Danvers	24,000	transfer	sticker plus card punch	$10/sticker/yr and ticket good for 12 trips to the station
East Brookfield	2,000	curbside	flat rate	$104/household/yr
Gloucester	27,500	curbside	sticker on bag	$0.50/sticker; attach to bag or on top of loose trash in barrel
Hinsdale	2,011	curbside	flat rate	$30/residence/yr
Holliston	13,000	curbside	flat rate	$75/household/yr
Marshfield	24,000	curbside	flat rate	$70/household/yr
Medway	10,000	curbside	flat rate	$15/household per month
Plainfield	500	transfer	card punch system	$25/card with 50 punches = $0.50/33 gallon bag
Sheffield	3,100	transfer	flat rate	$110/dwelling unit/yr
Southbridge	17,000	landfill	card punch system	$2/trip;fee to encourage use of town's curbside program

RESIDENTIAL TRASH FEES IN MASSACHUSETTS 1990 (Continued)

Webster	15,000	transfer	per bag recycling,	$1/bag if otherwise $2/bag
Wendell	885	transfer	card punch system	punch cards; $25/50 punches or $0.50/35 gallon bag

LANDFILL STICKER FEES 1990

MARSHFIELD	**POPULATION**	**FEE**
Ashfield	1,800	$ 35
Barnstable	36,431	45
Becket	1,410	40
Belchertown	10,000	50
Berlin	2,300	50
Bernardston	1,822	25
Bourne	16,000	7
Boxford	6,528	20
Chatham	6,500	35
Cohasset	7,300	52
Colrain	1,550	10
Concord	16,486	40
Dennis	14,000	50
Egremont	1,054	120
Fairhaven	15,600	5
Hadley	4,125	30
Holland	2,200	25
Hudson	18,500	10
Hull	10,000	50
Lakeville	7,000	$50 resident; $100 business
Leverett	1,900	35
Littleton	7,263	$50/6 months
Ludlow	18,000	$30 resident; $60 business
Mashpee	8,600	30
Mattapoisett	6,165	free res sticker; bus.coupons - prices vary
Middlefield	400	35
Middleton	5,113	10
Northfield	2,800	25
Otis	963	20
Palmer	11,952	$35 resident; $50 business
Pepperell	9,700	50
Plymouth	45,000	20
Rockport	7,000	30
Sandwich	16,000	35
South Hadley	16,800	5
Southwick	7,920	40
Southbridge	2,581	$1 one time fee for resident sticker
Sudbury	15,000	25
Upton	4,000	5
Wales	1,300	20
West Brookfield	3,259	25
Westhampton	1,137	75
Weston	10,200	$65/6 months
Williamsburg	2,380	$25
Williamstown	8,700	17
Winchendon	8,000	15
Windsor	695	15
Worthington	1,190	75
Yarmouth	20,000	50

APPENDIX G. SAMPLE MUNICIPAL LANDFILL BUDGET

DIRECT COSTS

COLLECTION:			
Rubbish Collection	$224,000		
Recyclables Collection	33,000		
Administrative Expenditures	7,500	$264,500	
DISPOSAL:			
Landfill Wages & Overtime	72,866		
Landfill Operating Expenditures	17,822		
Landfill Compactor Lease	31,700	122,388	$386,888

INDIRECT AND OVERHEAD COSTS

(See Indirect and Overhead Costs Detail)

a.	Administration - Highway Department	17,250	
b.	Engineering	3,000	
c.	Administration - Town	2,642	
d.	Treasurer	1,512	
e.	Collector	11,824	
f.	Data Processing	1,475	
g.	Pension	11,535	
h.	Health & Life Insurance	10,464	
i.	Workers' Compensation	13,510	
j.	General Insurance	2,000	
k.	Medicare	267	
l.	Payment in Lieu of Taxes	15,938	91,417
	LANDFILL CLOSURE AND POST CLOSURE RESERVE		200,000
	TOTAL		$678,305

INDIRECT AND OVERHEAD COST DETAIL

a.	Administration - Highway Dept.				
	Defined by Superintendent to be 15% of Highway Administration Division Budget:			15,000	17,250
b.	Engineering				
	Quarterly Inspections & Reporting to DEQE			750/Qtr.	3,000
c.	Administration - Town				
	Budget (Administration, Accounting, Audit)			145,000	
	Direct Cost Budget divided by	386,888			
	Total Operating Budget	21,235,000	=	1.8%	2,642
d.	Treasurer				
	Operating Budget			83,000	
	Direct Cost Budget divided by	386,888			
	Total Operating Budget	21,235,000	=	1.8%	1,512

e. Collector

Operating Budget	68,500			
# Trash/Commercial Bills		7,250		
Total # Bills Sent, All Types		42,000	= 17.3%	11,824

f. Data Processing

Hardware Maintenance (5%)	17,500	875	
Software Maintenance (1/3)	1,500	500	
Supplies (5%)	2,000	100	1,475

g. Pension:

Pension Assessment x		710,000	
Salaries divided by	72,866		
Total Salaries (Pensionable)	4,485,000	1.6%	11,535

h. Health & Life Insurance

2 Family Plan BC/BS	x	298/month	=	7,152	
2 Individual Plan BC/BS	x	138/month	=	3,312	10,464

i. Workers' Compensation

Labor Wages	65,000	x	20.74 rate	=	13,481
Clerical Wages	7,866	x	00.37 rate	=	29
	72,866				13,510

j. General Insurance

Liability/Fleet Policy (Est. by Insurance Carrier)	2,000

k. Medicare (1.45%) Wages subject to: 1 laborer @ $18,414	267

l. Payments in Lieu of Taxes

Property Valuation $125,000 x 12.75 tax rate = 15,938

REVENUE REQUIREMENT WORKSHEET

REVENUE REQUIREMENT TO BE RECOVERED THROUGH RATES

LESS REVENUE REQUIREMENT FROM COMMERCIAL DUMPING

Rate/Ton x number of tons of commercial dumping

REVENUE REQUIREMENT TO BE RECOVERED FROM RESIDENTIAL USERS

Revenue to be Recovered from Residential Dumping

Sticker Fee Rate x Number of Stickers

Dumping Fee Rate x Pounds/100 Dumped

Revenue to be Recovered from Residential Curbside Pickup

Remaining Revenue to be Recovered/# Residential Pickups

CURBSIDE PICKUP FEE CALCULATION

REVENUE REQUIREMENT TO BE RECOVERED THROUGH RATES	678,305
LESS REVENUE REQUIREMENT FROM COMMERCIAL DUMPING	
Rate/Ton x number of tons of commercial dumping $65 x 950,000	61,750
REVENUE REQUIREMENT TO BE RECOVERED FROM RESIDENTIAL USERS	616,555
Revenue to be Recovered from Residential Dumping	
Sticker Fee Rate x Number of Stickers $10 x 400	4,000
Dumping Fee Rate x Pounds/100 Dumped $3.25 x 31,200/100	1,014
Revenue to be Recovered from Residential Curbside Pickup	611,541
# Residential Curbside Pickups	5,500
Revenue to be Recovered per Residential Curbside Pickup	$112

REVENUE PROJECTION AT NEW RATES

I.	**Commercial Dumping Revenue**		
	Tipping Fee	$65 per ton	
	Highway Superintendent's Estimated Tonnage for FY'92	950	$61,750
II.	**Residential Curbside Pickup**		
	Annual Flat Fee	$112/house	
	Highway Superintendent & Health Agent's estimate of # of households participating	5,500	616,000
III.	**Residential Non-Curbside**		
	Landfill Sticker Fee	$10	
	Est. # Residential Stickers	400	4,000
	Dumping Fee per 100 pounds		
	Highway Superintendent's	$3.25	
	Estimate of # pounds dumped	312	1,014
			$682,764

An additional $611,541 to be recovered form 5,500 residential curbside pickups for an annual fee of $112.00.

Once the rates are computed, a revenue projection at new rates analysis is needed to verify that the new rates will produce the desired revenue. As shown below, the aggregate of the commercial dumping revenue, curbside residential pickup and residential non-curbside fees produce $682,764 slightly more than the $678,305 to be recovered through rates.

APPENDIX H. PURCHASING GIS MAPS

A party conducting a landfill assessment must submit a regional locus map of the area surrounding the landfill site (Tasks 1.6 and 2.2 of the assessment Outline). The Division of Solid Waste Management in cooperation with the MassGIS office has incorporated the State's solid waste facilities onto the MassGIS system and can produce low cost computer generated maps for use in completing a landfill assessment.

What Is GIS:

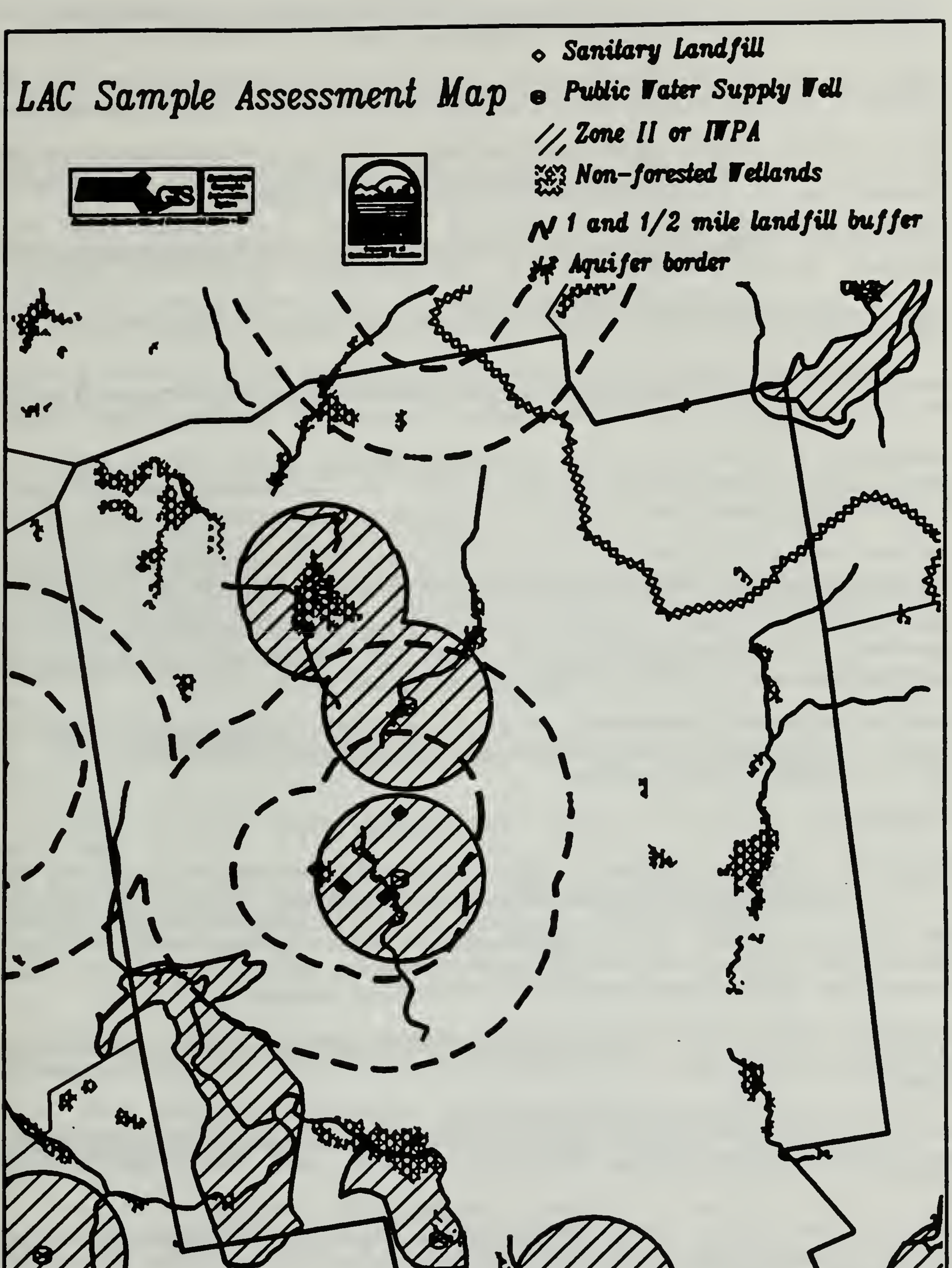
A Geographical Information System is an integrated software package consisting of mapping and database components. The system allows for detailed mapping of site information constructed in one or more data layers or overlays. The systems database capability provides the entry point for tabular information which can be attached to the graphically mapped features. MassGIS is the Executive Office of Environmental Affairs (EOEA) state-wide GIS system. The MassGIS data base has been constructed over the past six years and provides an extensive database consisting of state-wide data layers of key environmental information. The majority of the data base was constructed from base maps at a scale of 1:25,000.

Why Use GIS Maps:

The automated "Solid Waste Assessment" GIS map set consists of two maps at a 1:25,000 scale with your community at the center point of the map. The Resource Map includes Zone II's and Interim Wellhead Protection Areas, surface water supplies, non-forested wetlands, drainage basin delineation, aquifers and sanitary landfills. The Land-use Map includes typical zoning type classifications determined from areal photo interpretation based on 1985 photos. The two maps contain most, if not all, of the information necessary for the locus mapping required for assessment submittals. They can also be used by local officals to advocate for landfill closure and other resource protection activities. A rough sample map is included on the following page.

How To Obtain These Maps:

The GIS Solid Waste Assessment Maps can be ordered from the Division of Solid Waste Management at a cost of $100.00 per set. Often, with smaller communities, both maps can be plotted on one map sheet reducing the cost to $50.00. You can call the Division at (617) 292-5987 to determine the cost of the map, or send a check for $100.00 made out to the Commonwealth of Massachusetts with a letter requesting the maps. Mail requests to LAC Program, DEP-DSWM, Fourth Floor, One Winter, Boston, MA. 02108. If the maps fit on one sheet, two copies of the map set will be sent to you.


LAC Sample Assessment Map
Sanitary Landfill
Public Water Supply Well
Zone II or IWPA
Non-forested Wetlands
1 and 1/2 mile landfill buffer
Aquifer border
GIS

APPENDIX I. REFERENCES

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APPENDIX J. DSWM POLICIES AND PUBLICATIONS

The following is a list of publications developed by the Division of Solid Waste Management (DSWM) of the Massachusetts Department of Environmental Protection (DEP). The documents listed on this page are available from the State House Bookstore and the documents listed on subsequent pages are available directly from the DSWM.

State House Bookstore: The State House Bookstore is in the State House in Boston. For information on prices and ordering, call the Bookstore at (617)727-2836.

Division of Solid Waste: There is a charge for most documents obtained from the DSWM. However, this charge is waived for governments and non-profit organizations. To order any of the documents on pages 2-4, send your request on your letterhead to the Massachusetts Department of Environmental Protection, Division of Solid Waste Management, One Winter Street, Boston, MA 02108. If you have questions, please contact the DSWM at (617)292-5960.

DOCUMENTS AVAILABLE FROM THE STATE HOUSE BOOKSTORE

DSWM Regulations:

Site Assignment Regulations for Solid Waste Management Facilities, 310 CMR 16.00 (5/11/1990).

Solid Waste Management Facility Regulations, 310 CMR 19.000 (10/12/1990).

Solid Waste Master Plan:

Toward a System of Integrated Solid Waste Management, The Commonwealth Master Plan (June, 1990)

School Resource Guide:

The Solid Waste Management Resource Guide for Massachusetts Schools (Aug., 1990)

Plastics Recycling

Plastics Recycling Action Plan for Massachusetts (1988)

DOCUMENTS AVAILABLE FROM THE DSWM

DSWM POLICIES IN EFFECT AS OF JANUARY, 1992:

#SWM-2	Interim Oil Ash Disposal Policy (Effective: February 7, 1983)
#SWM-3	Coal Ash Landfill Cover and Disposal Policy (Effective: May 18, 1983)
#SWM-4	Urea Formaldehyde Foam Insulation (UFFI) (Effective: March 4, 1988)
#SWM-5	Tire Stockpiling and Disposal (Effective: June 4, 1987)
#SWM-7	Ash Management and Disposal Policy (Effective: August 3, 1988)
#SWM-9	Ash Sampling and Analysis Guidance (Effective: July 29, 1988)
#SWM-10	Establishment and Enforcement of Tonnage Limits at Solid Waste Facilities (Effective: June 26, 1989)
#SWM-11	Interim Policy Alternative Uses of Asphalt, Brick and Concrete Rubble (Effective: June 29, 1989)
12.	Reserved (There has never been an #SWM -12)
GUIDELINE	Asbestos Guideline for Storage, Consolidation, and Transfer of Asbestos Waste (Effective: March 24, 1988)

DSWM POLICIES THAT HAVE BEEN REPEALED AS OF JANUARY, 1992:

#SWM-1.	Handling and Disposal of "NON FRIABLE" Asbestos Waste (Effective: June 20, 1979) (Repealed: April 10, 1991)
#SWM-6	Woodwaste Disposal (Effective: August 14, 1987) (Repealed: April 10, 1991)
#SWM-8	Leaf Composting Policy (Effective: 1988) (Repealed: April 10, 1991)
#SWM-13	Interim Policy on Issuance of Solid Waste Management Facility Permits (Effective: June, 1989) (Repealed: April 10, 1991)

DSWM GUIDANCE DOCUMENTS:

1-10/90	Lead Acid Battery Bans (Implementation Guidance)
2-4/91	Existing Solid Waste Management Facility Repermitting Guidance (April, 1991)
3-4/91	Landfill Assessment and Cleanup Repermitting Guidance (April, 1991)
4-4/91	Financial Assurance Requirements Guidance Document (April, 1991). Financial Instrument Forms are available for: Trust Agreement Performance Bond Financial Guarantee Bond Irrevocable Standby Letter of Credit

5-4/91 25% Recycling Requirement Guidance Document (April, 1991)

6-7/91 Guidance to Solid Waste Disposal Facilities for Implementation of the Bans Relative to the Disposal of Leaves, White Goods and Restriction on Disposal of Whole Tires (July, 1991)

DRAFT Landfill Technical Guidance Document (Draft, 2/21/91)

Outline for Solid Waste Site Assessment (October, 1991)

Guidance on Conducting Qualitative Risk Assessments at Solid Waste Landfills (August, 1991)

MISCELLANEOUS INFORMATION:

A Guide to the Solid Waste Management Regulations (310 CMR 16 & 19) (February, 1991)

Landfill Assessment and Closure Training Manual (August, 1991)

Massachusetts Solid Waste Master Plan, Population and Generation Rate Numbers (June, 1990)

LISTS OF FACILITIES IN MASSACHUSETTS:

The following lists of facilities in Massachusetts are generated from the DSWM's database and are periodically updated.

- Inactive Landfills
- Active Landfills & Active Landfills with Liners
- Demolition Landfills (accept only construction and demolition wastes)
- Transfer Stations
- Active Stump Dumps
- Tire Piles
- Status Report on Cities and Towns
- Waste-to-Energy and Incinerators

RECYCLING LITERATURE:

Recycling in Massachusetts, a Status Report (Dec., 1991)

Waste Composition Studies (1985)

Apartment Building Recycling A Manual for Apartment Owners and Managers (1990)

Transfer Stations (1985)

Public Education (1985)

Recycling Programs In Massachusetts Cities and Towns/Curbside and/or Drop-Off (Jan., 1992)

Cities and Towns with Mandatory Recycling Ordinances (Sept., 1991)

Recyclable Material Markets (Feb., 1992)

Recycled Products Guide (Dec., 1990)

Apartment Building Recycling Municipal Guidence Manual (1988)

Commercial Recycling Fact Sheet (1992)

Guide to Community Recycling (1992)

Recycling Questions (1992)

COMPOSTING LITERATURE (municipal-scale composting operations):

Planning for a Municipal Leaf Composting Program (1990)

Leaf and Yard Waste Composting Guidance Document (9/91)

Notes for a Short Course on Municipal Scale Leaf and Yard Waste Composting (1991)

Table of Collection Options (1/89)

Thermometer and Paper Bag Suppliers

Leaf and Yard Waste Composting Economics (1990)

Recommendations for Grass Composting (Municipal Scale) (1991)

Commercial Leaf Composting Facilities and Management Services (list) (8/91)

How to Start a Christmas Tree Chipping Program (12/90)

COMPOSTING LITERATURE (home composting and source reduction):

Backyard Composting (brochure) (1990)

Grass Clippings - Let Them Work for You (brochure) (1990)

Home Composting Bin Design Sheets

Vermicomposting Information and Bin Design Sheets

Home Composting Handbook: How to Promote Home Composting in Your Community (1991)

Strategies to Promote Source Reduction of Yard Wastes (1991)

Network of Home Composters Program Information Sheet (1991)

APPENDIX K. TRAINING MANUAL CREDITS

TRAINING PROGRAM DEVELOPMENT TEAM

GRANT MANAGERS

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